Motherboard Upgrades: Avoid Win95 Hassles

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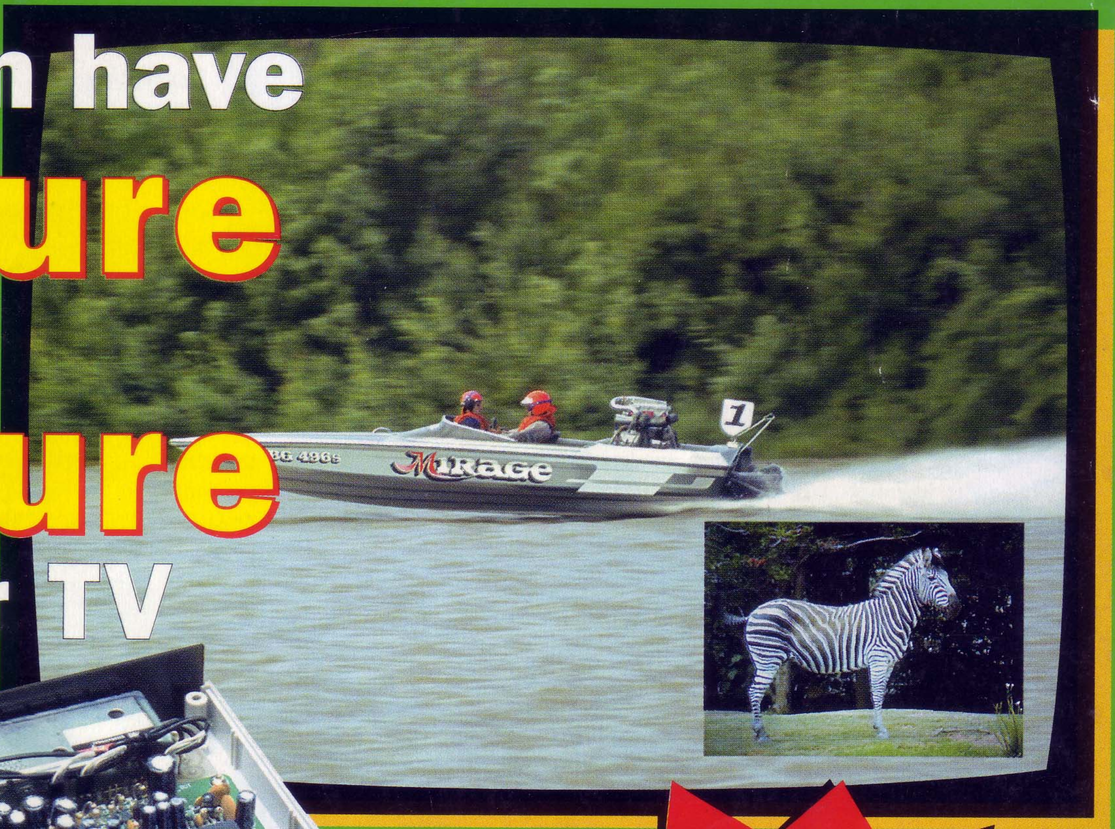

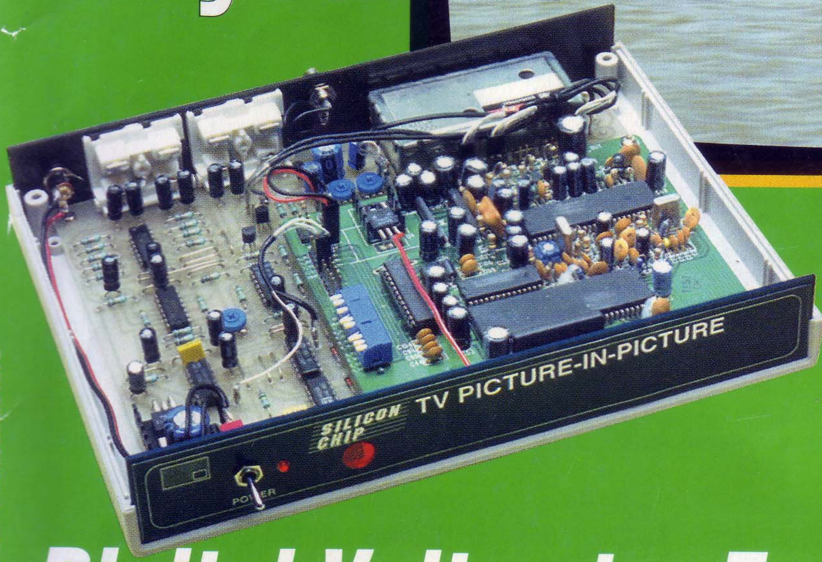

Universal Loudspeaker Protector

Digital Voltmeter For Cars

Simple Model Train Controller

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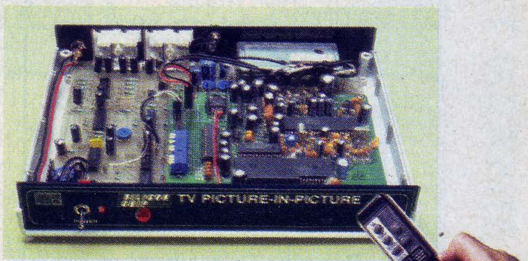

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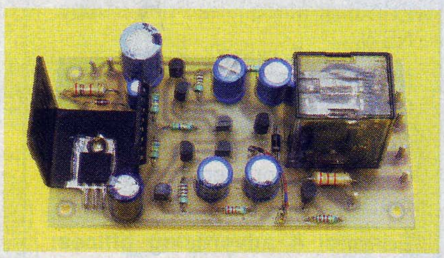

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Publisher & Editor-in-Chief
Leo Simpson, B.Bus., FAICD

Editor
Greg Swain, B.Sc.(Hons.)

Technical Staff
John Clarke, B.E.(Elec.)
Robert Flynn
Rick Walters

Reader Services
Ann Jenkinson

Advertising Manager
Brendon Sheridan
Phone (03) 9720 9198
Mobile 0416 009 217

Regular Contributors
Brendan Akhurst
Garry Cratt, VK2YBX
Julian Edgar, Dip.T.(Sec.), B.Ed
John Hill
Mike Sheriff, B.Sc, VK2YFK
Ross Tester
Philip Watson, MIREE, VK2ZPW
Bob Young

Photography
Glenn A. Keep

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PUBLISHER'S LETTER

Marketing hype doesn't sell anything

One of the disadvantages of the all the new so-called high technology devices which are swamping the market is the high level of marketing nonsense which accompanies these products. In fact, there is so much "hype" in today's marketplace that it must build up the suspicion, at least in the minds of cynical buyers, that most of these new products aren't what they're cracked up to be.

It affects us here at SILICON CHIP too. Every day, lots of press releases come over the desk and when we read some of them we wonder why the companies concerned ever bothered producing the product; if they need that much hype, they must be garbage!

As you might expect, a lot of these press releases never see the light of day, or at least they don't appear in SILICON CHIP. Others we attempt to make some sense of, filtering out the real information from the bull. You'd be amazed at how often a two or three page press release comes down to just a couple of paragraphs.

Just to give you some idea of the level of this nonsense, I'll give you a few examples. One of the common claims is that a product is "ergonomically designed". As far as I can determine, such a product has knobs or buttons on it which have some function. At least, I don't think any manufacturer would admit to producing a device that was "not ergonomically designed".

Then there are products, often software, which offer "full functionality" on a PC, Mac or whatever. I think this means that they will work on a PC, Mac or whatever. I really don't think that these products would be on sale if they didn't offer this "full functionality" but then again, you never know.

Of course, all software that runs under Windows 95 or NT is "interactive and easy to use" which is, as anyone who has used some of this software knows, a load of old cobblers. Of course, many CAD programs are intuitive as well, which I think means that you can use them before you've opened the manual. We know that's not true either.

And the reason they're "intuitive" is to "increase the design throughput, minimising commissioning times and speeding up the product time-to-market cycle". Heaven forbid that any product or software would actually slow down the product time-to-market cycle. That wouldn't do at all, would it?

For me, much of this hype appears to be written by public relations people who really don't have a clue what they are writing about, or perhaps, the products concerned really don't have any features worth talking about anyway.

More than ever, the warning "Caveat Emptor" or "Let the Buyer Beware" is as relevant today as it ever was. So look out. If you see meaningless hype accompanying a product, watch out. And if you are the person who actually writes this stuff, please don't.

Leo Simpson

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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By JULIAN EDGAR

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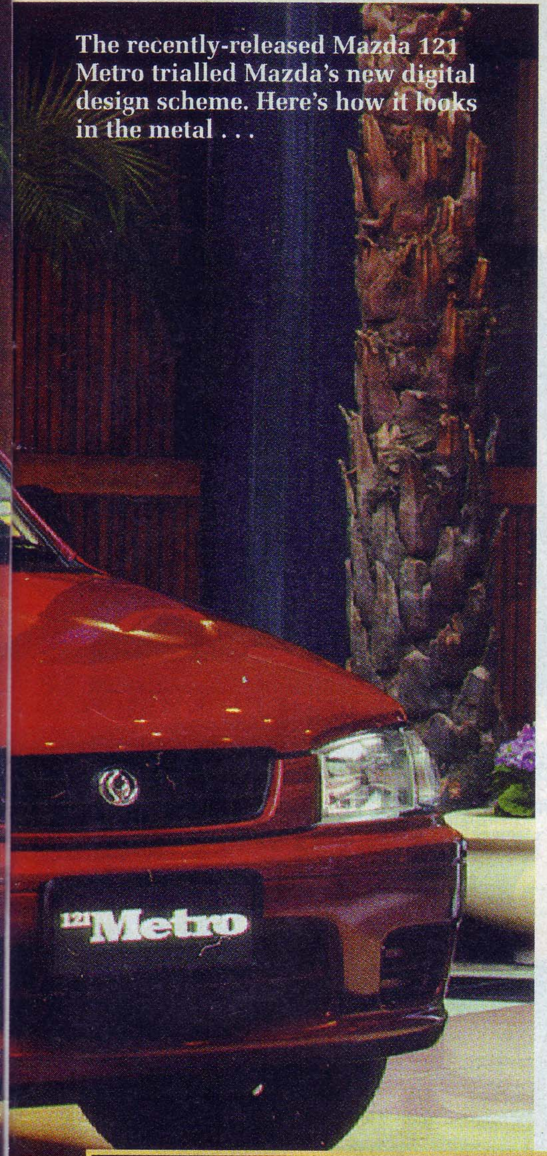
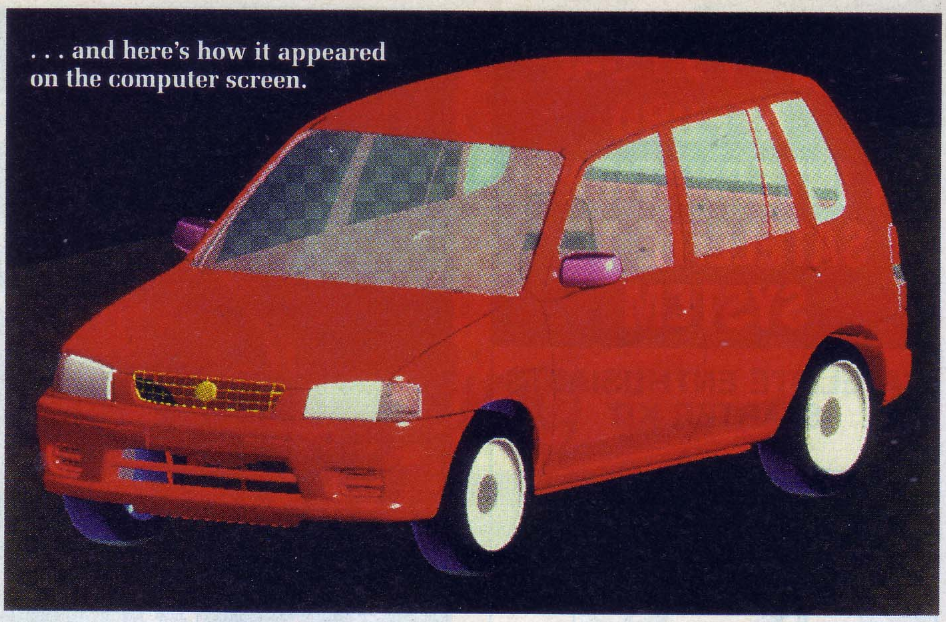


The recently-released Mazda 121 Metro trialled Mazda's new digital design scheme. Here's how it looks in the metal . . .



. . . and here's how it appeared on the computer screen.

The "paperless aeroplane" is soon to be followed by the "paperless car". Just as Boeing entirely designed their 777 airliner on computer screens, so Mazda expects to follow with automotive design.

Long recognised as one of the world's most innovative car manufacturers, Mazda is to invest more than $A200 million in a process that will see new cars designed completely on computer screens. The new process, known as the Mazda Digital Innovation (MDI) scheme, will cover all design stages from R&D through to actual component production.

Mazda says that MDI is being developed so that the company can quickly respond to changes in demand and produce profits from even relatively small-scale production runs. Of the $A200 million to be invested, $A111 million will be spent on computer hardware and software and a further $A88 million on machines and equipment. Around 4000 new computers are to be bought, while a further 1000 existing machines are to be upgraded.

In the MDI system, product design and production engineering will be developed 3-dimensionally. All product data will be digitally processed to create digital mock-ups. This will allow the simulation of:

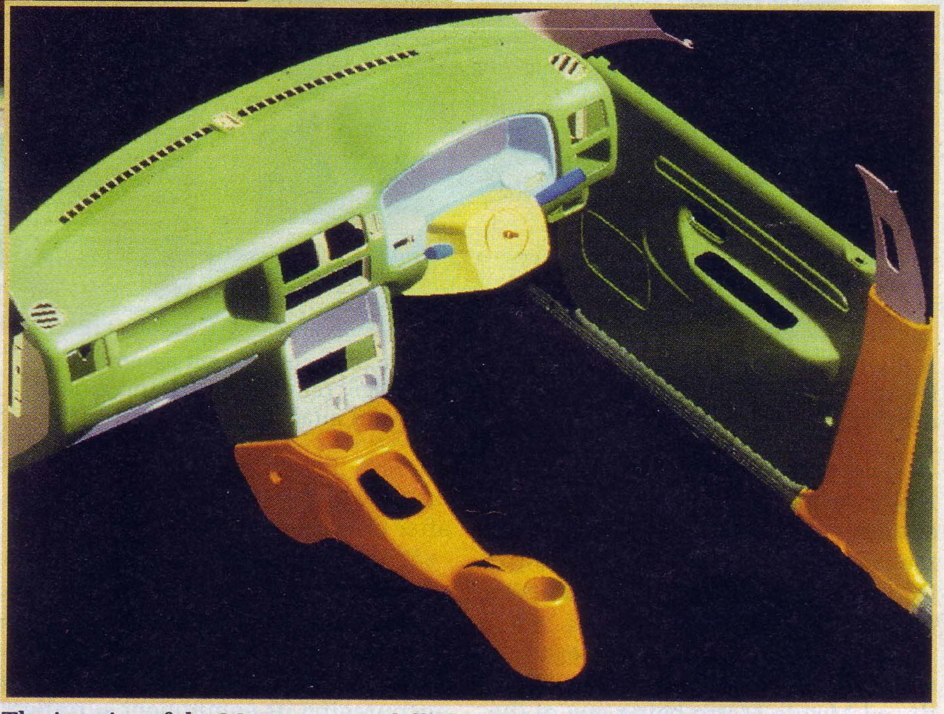
(1) layouts of the engine bay, cabin, etc;

(2) interference and gaps between adjoining parts;

(3) ease of maintenance and access to parts; and

(4) ease of assembly.

In addition to the shape of the object, product data such as quality, performance and cost will be digitised. Advanced machining and assembly



The interior of the Metro was modelled in digital 3-dimensional form prior to construction. As well as providing a broad overview, this approach also allows the design to be examined for errors and ease of assembly.

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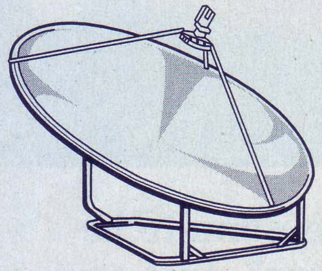

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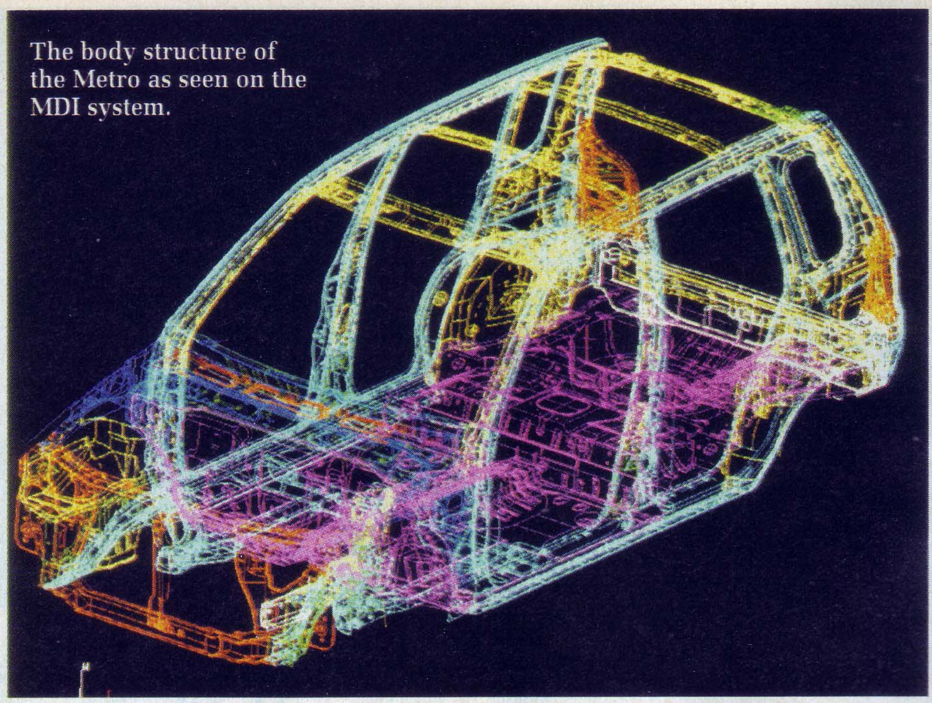
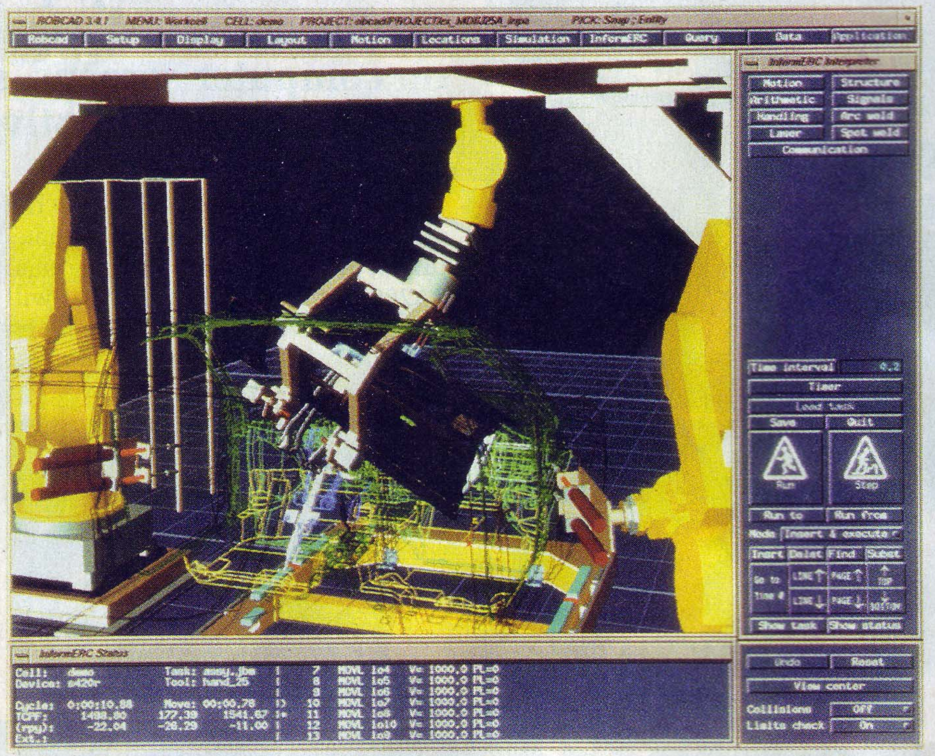


The body structure of the Metro as seen on the MDI system.



A digital machine in a digital factory conducts a trial component assembly. Design changes can be made with ease at this stage, reducing costs and model development time and potentially improving build quality.

facilities will be introduced and the system will also contribute to factory management, keeping track of such things as process control, labour hours and quality control.

Trials of the new system began as early as mid-1995, the recently-introduced Mazda Metro being one of the vehicles used to "prove" the process. The company plans to fully apply MDI on all vehicles whose design is frozen after the spring of this year.

With most of the component parts of a car produced and often developed by external suppliers, this type of design process cannot be undertaken in isolation. Mazda is therefore encouraging its component suppliers to also make use of the new system, so that it is fully effective. **SC**

Motherboard upgrades for your computer

How to avoid reinstalling Windows 95

You don't have to reinstall Windows 95 when you upgrade the motherboard in your computer. Here's how to save time and avoid the hassles of reinstallation.

By JASON COLE

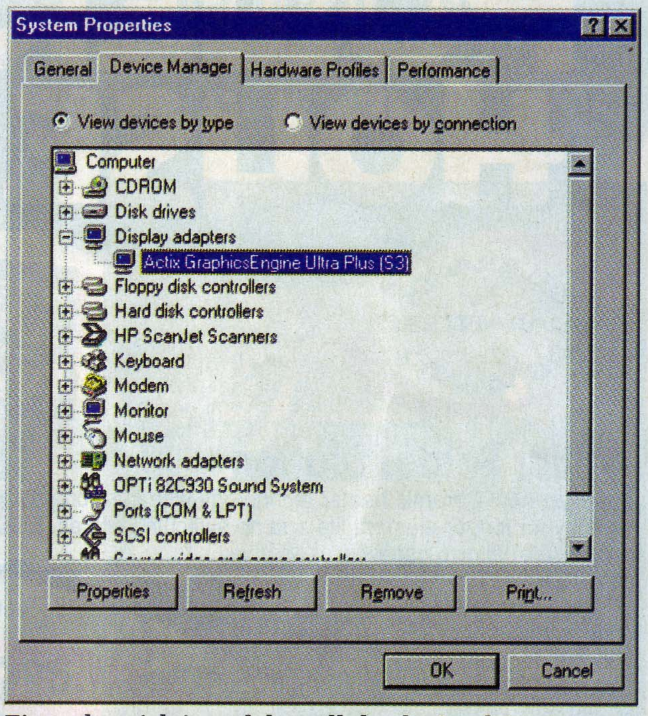


Fig.1: the trick is to delete all the device drivers before removing the old motherboard. You do that by selecting each device in turn and clicking Remove.

In the article, "*!#$*&@* Computers" in the February 1997 issue, the author referred to the need to reinstall Windows after replacing the motherboard in his system. However, provided your old motherboard hasn't failed and you are simply upgrading, you don't have to do this.

The trick is to remove all the device drivers for your hardware before removing the old board. Here is the procedure I use and it does work as I have done it numerous times:

(1) Either boot into SAFE MODE or exit into DOS and type WIN/D:M (ie, start Windows in SAFE MODE with no network).

(2) When Windows has loaded in safe mode, click on the START button then select SETTINGS and CONTROL PANEL. In the Control Panel, double click on SYSTEM. This brings up the System Properties box.

(3) Click on the DEVICE MANAGER tab and systematically remove all devices. This deletes that portion of the registry that contains the hardware profiles. A couple of things to note:

(a) Occasionally, after deleting the keyboard, mouse or Com Port 1 (usually the Mouse port), you may lose control of the keyboard or mouse. So, if possible, remove these last otherwise continue using the keyboard or restart again straight into SAFE MODE. This can be done by pressing F8 when the "Booting Windows 95" message appears and selecting SAFE MODE from the list of options. Keyboard control should return.

(b) When removing the Standard IDE/ESDI Hard Disk Controller, remember that these are the parent devices and that the Primary/Secondary IDE Controller cannot be removed on its own.

(4) When all the devices have been removed click the START button, then select SHUT DOWN and SHUT DOWN THE COMPUTER.

(5) When the computer has shut down, switch off the power and install the new motherboard and any new cards. When Windows 95 starts up again with the new motherboard, it initially does not know what it has to work with. This is exactly the same as if you had installed Windows 95 from scratch or if you reinstalled it.

(6) When it starts for the first time after replacing the motherboard, Windows 95 will detect that it has no video adapter setting and offers to detect it automatically. At this point, click on YES and allow it to do an auto detect for hardware components (otherwise known as the "Add New Hardware Wizard").

(7) Once it has finished detecting the video card, you may be asked to restart the computer to implement the changes. Upon restarting, the new Plug and Play (PnP) BIOS will continue to detect components and update the registry.

Any non-PnP cards that are not detected should be installed manually in the usual way (see Feb. 1997). **SC**

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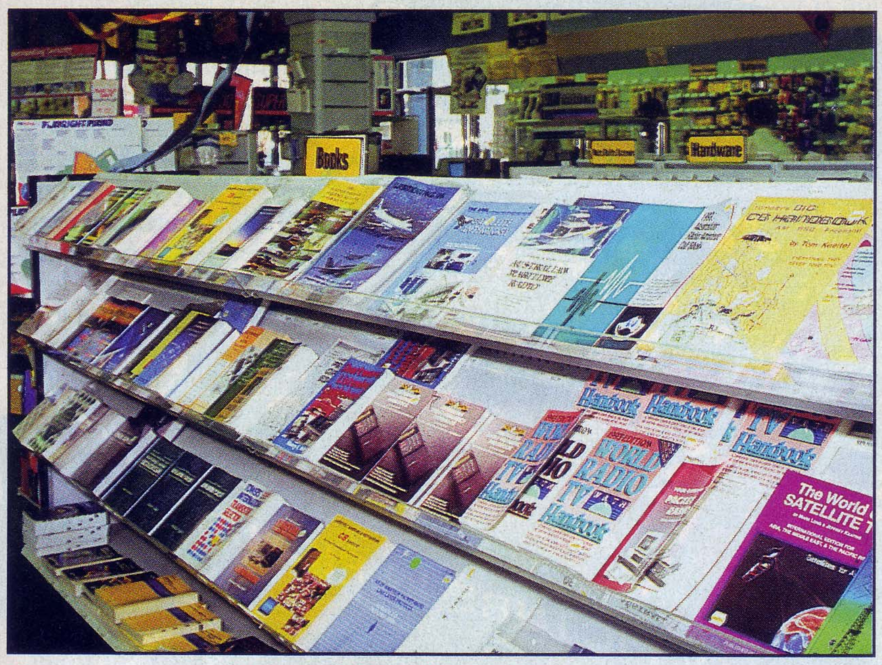

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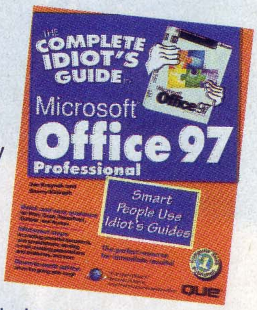

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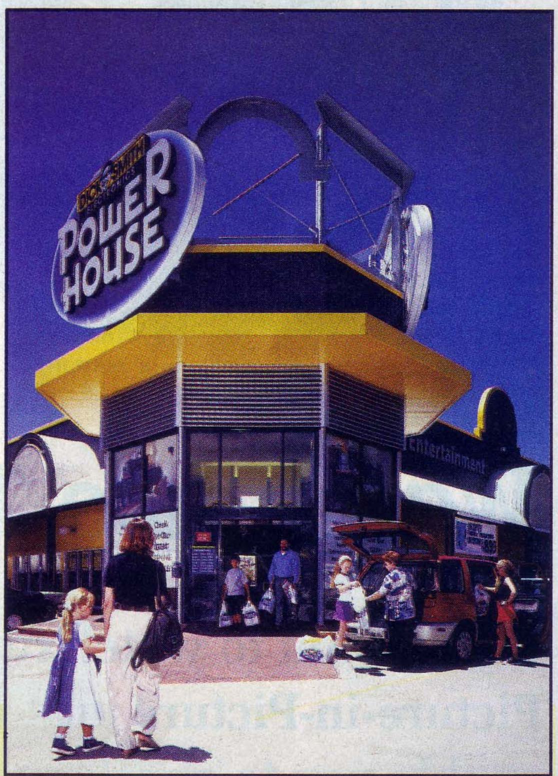

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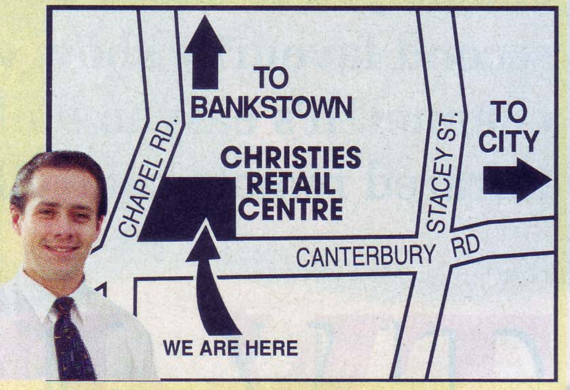

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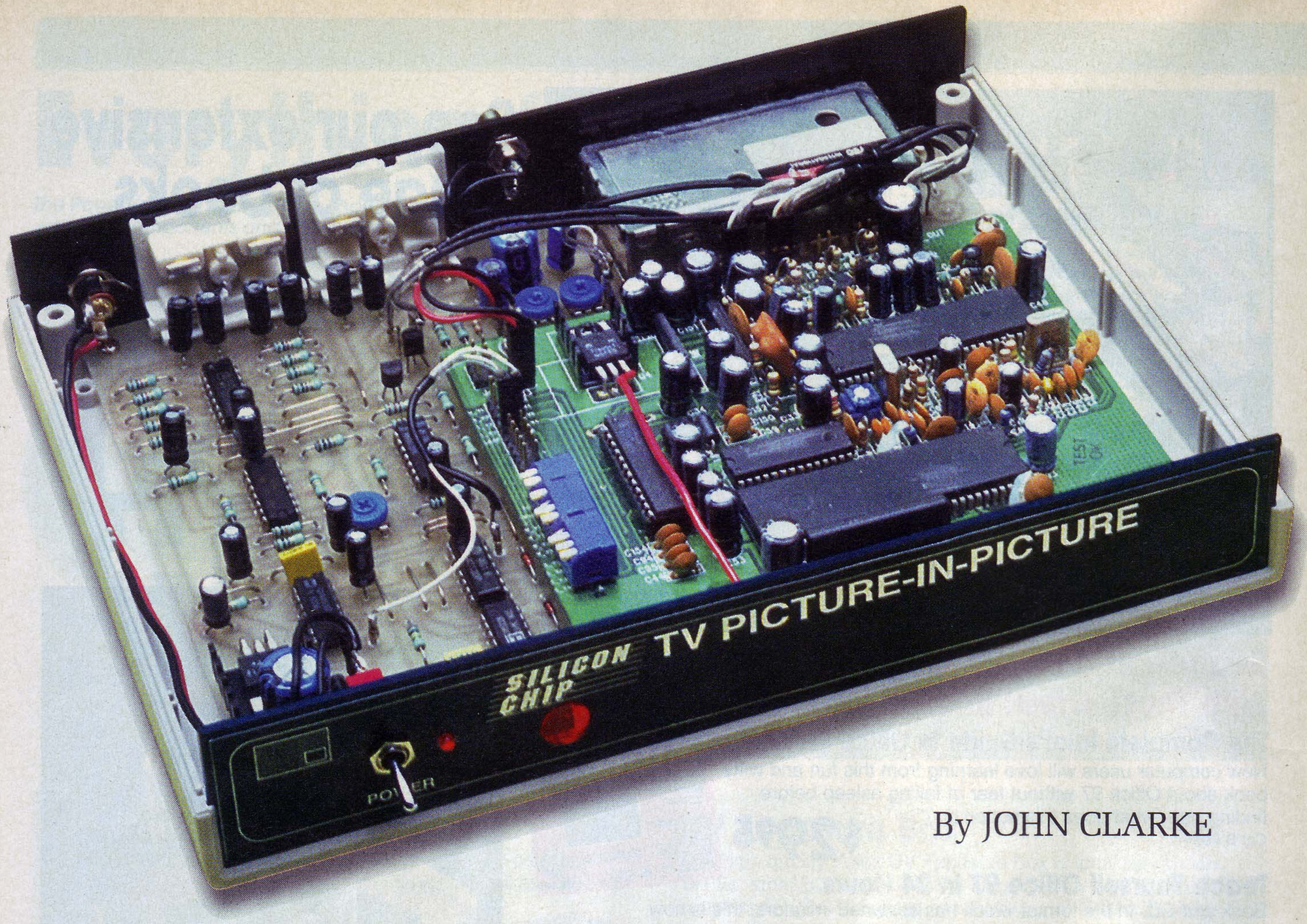


By JOHN CLARKE

Watch two TV channels at once!

If you want to watch two TV channels at once, this Picture-in-Picture unit will come in handy. It will enable you to check on the golf, cricket or your second favourite show while also watching another channel. It's easy to build and all functions are infrared remote controlled.

TV Picture-in-

HOW MANY times have you wanted to see what is happening on a second TV channel while watching another program? It may be that the program that you want to watch next starts before the present one is finished or there are two programs that you want to see but they are showing at the same time. You may also want to watch another channel while the advertisements are on but not want to miss the show when it comes back on. With this Picture-in-Picture unit you can do all those things and more.

Picture-in-picture or PIP on a television screen means that there is a second small picture of another channel superimposed on the main picture. It is usually about 1/6th the size of the screen and so it does not normally detract too seriously from the main program. If it does cause problems, it can either quickly be switched off or "flicked" (using the ROTATE button) to another corner of the screen.

You can also quickly swap the PIP with the main picture, just by pressing the SWAP button on the remote control. When this is done, the original PIP is viewed full size, while the original full-sized program is shrunk to the smaller PIP area. The sound is automatically swapped with the picture.

Note that you can also swap the sound from one channel to the other, so that either the main or PIP channel can be heard.

Another very useful feature is a sound muting facility. This is particularly handy for advertisements which are usually at a louder volume than normal program material.

As shown in the photos, the TV Picture-In-Picture Unit is housed in a slimline plastic case with terminals at the rear for the audio and video connections. On the front is the power switch, a power indicator LED and a window for the infrared remote control sensor. The handheld remote control takes care of all functions, except for power on/off switching.

To make the construction easy, the PIP unit is based on a pre-built module which performs all the video functions. We have added in the audio and remote control facilities to complete the unit.

What you need

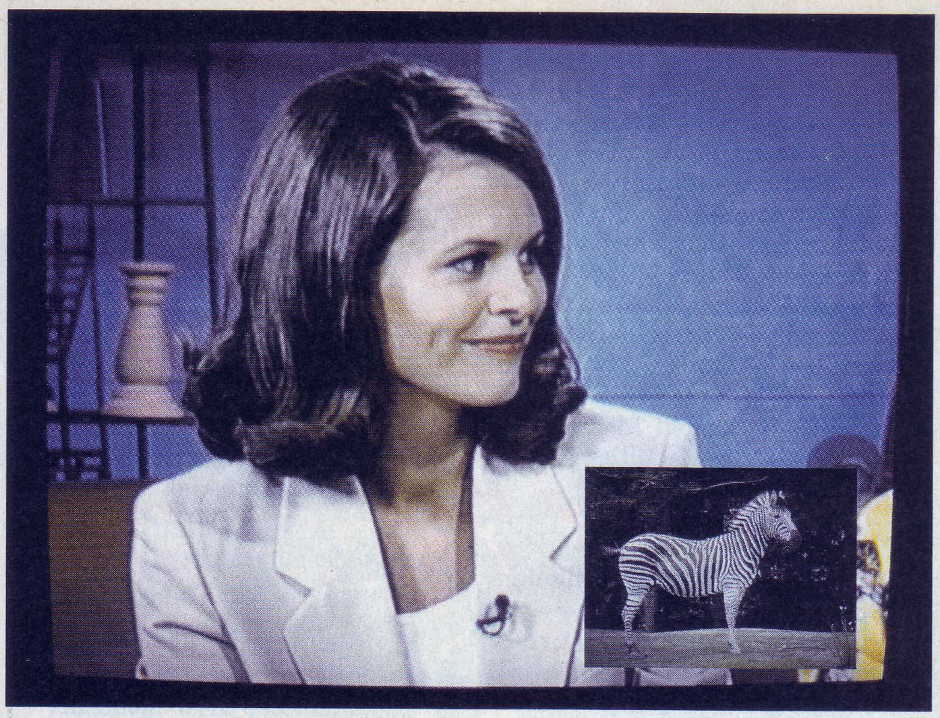
Two video sources are required for the PIP unit to operate and this would normally be provided by two video players. Just about every household has at least one VCR and many have two, although often the tape transport mechanism in the older unit has failed.

Main Features

- Adds a small picture (PIP) of another channel to one corner of the TV screen
- PIP can be displayed in any corner of the screen
- Main picture & PIP can be swapped at the press of a button
- Audio automatically swaps with picture swap
- Audio signal can be either for the main picture or for the PIP
- Audio mute facility
- Stereo or mono audio
- Remote control functions for all features
- Direct video or RF modulator output (channel 0 or 1)

This handpiece remotely selects all the functions of the Picture-In-Picture Unit. It lets you move the PIP to any corner of the screen, swap between the PIP and the main picture, and swap and mute the audio.

Picture Unit



By default, the PIP appears in the bottom righthand corner of the screen when it is turned on. It can be moved to any of the other corners of the screen at the press of a button. Note that the PIP quality is not as good as the main picture.

That doesn't matter – it's the tuner section of the older unit that we're really after and provided that still works, it can be pressed into service.

If you don't have a second VCR, you can probably obtain a junked unit quite cheaply from a video repair shop. Don't worry too much about the tape transport mechanism – just make sure that the tuner/RF section works. An old Beta player could probably be picked up for a few dollars (or even given away), for example.

Although using two VCRs to provide the two channels is the obvious way to go, it may be possible to modify the TV set in some cases so that it can function as a signal source. That way, only one VCR would be necessary to provide the second channel. Modifying the TV set would involve breaking the audio and video signal paths at the appropriate points so that the PIP unit can be interposed.

Don't do this unless you are experienced with TV/video circuits and know exactly what you are doing. Be aware also that some older TV sets may have a live chassis and that any modifications will invalidate the set's warranty. Add in any technical difficulties that you may encounter (signal levels, etc) and you can see why we recommend the two-VCR approach.

Fig.1 shows a typical installation for the PIP Unit. The two VCRs receive the incoming RF from the antenna via a splitter and their audio and video outputs are fed to the PIP Unit. The RF modulated output from the PIP unit (channel 0 or 1) is then fed to the antenna input (RF IN) of the TV receiver.

Alternatively, the audio and video outputs from the PIP Unit can be fed to the TV receiver, provided the set has provision for these inputs. The left and right (L & R) audio outputs can also be fed to a stereo amplifier.

Note that although Fig.1 depicts stereo VCRs, mono VCRs can also be used – just use mono cables and connect to either the left or right audio channel of the PIP unit.

Block diagram

Fig.2 shows the block diagram of the TV PIP Unit which can be divided into audio and video sections. The audio section (IC5, IC6a, IC6b & IC6d) accepts the stereo inputs from the VCRs and produces a single output (AUDIO OUT) which may be switched between either VCR or muted. In addition, the left and right channels of the selected source are mixed to produce a mono signal which is fed to the video modulator audio input.

The video outputs from the VCRs are fed to the video inputs of the PIP board. The output from this board is either video 1, video 2 or a picture-in-picture signal. This output is then split two ways. First, it is buffered by driver stage Q4 to provide the video output signal. And second, it is fed to the video modulator which produces the alternative RF output signal.

As mentioned before, the remote transmitter controls all the functions of the PIP unit. The PIP button switches the picture-in-picture display on or off, while the SWAP button below it switches the PIP and full-screen channels (the audio automatically swaps as well). You can also use the

adjacent audio SWAP button to switch the sound from the main picture to the PIP, or vice versa.

The ROTATE button selects which corner of the screen plays host to the PIP. This button sequentially moves the PIP display anticlockwise to the next corner of the screen each time it is pressed.

Finally, as its name implies, the MUTE button kills the audio.

The signals from the remote control unit are picked up by a remote control receiver circuit which is based on IC1. Its output is then fed to the control logic block (IC2-IC4) and this in turn controls the audio switching and the PIP board.

Circuit details – transmitter

Fig.3 shows the circuit for the IR Transmitter. IC1 is an SM5021B encoder which outputs a unique code for each switch. This code gates a 38kHz carrier on and off and the output at pin 15 then drives Darlington transistor pair Q1 & Q2. These in turn drive IRLED1 via a 4.7Ω current limiting resistor. The 38kHz carrier is derived by dividing the 455kHz oscillator frequency at pins 12 & 13 by 12.

LK1 and LK2 are included to alter the coding for each switch. This will

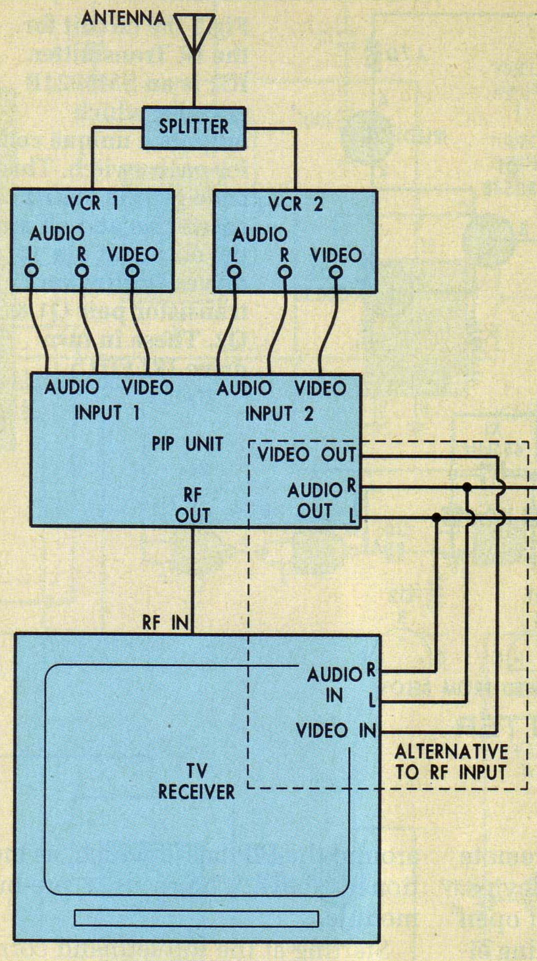


Fig.1: the PIP Unit accepts video and audio signals from two VCRs. The processed output from the PIP Unit is then fed to the TV set, either via the antenna socket or via video and audio inputs (if fitted).

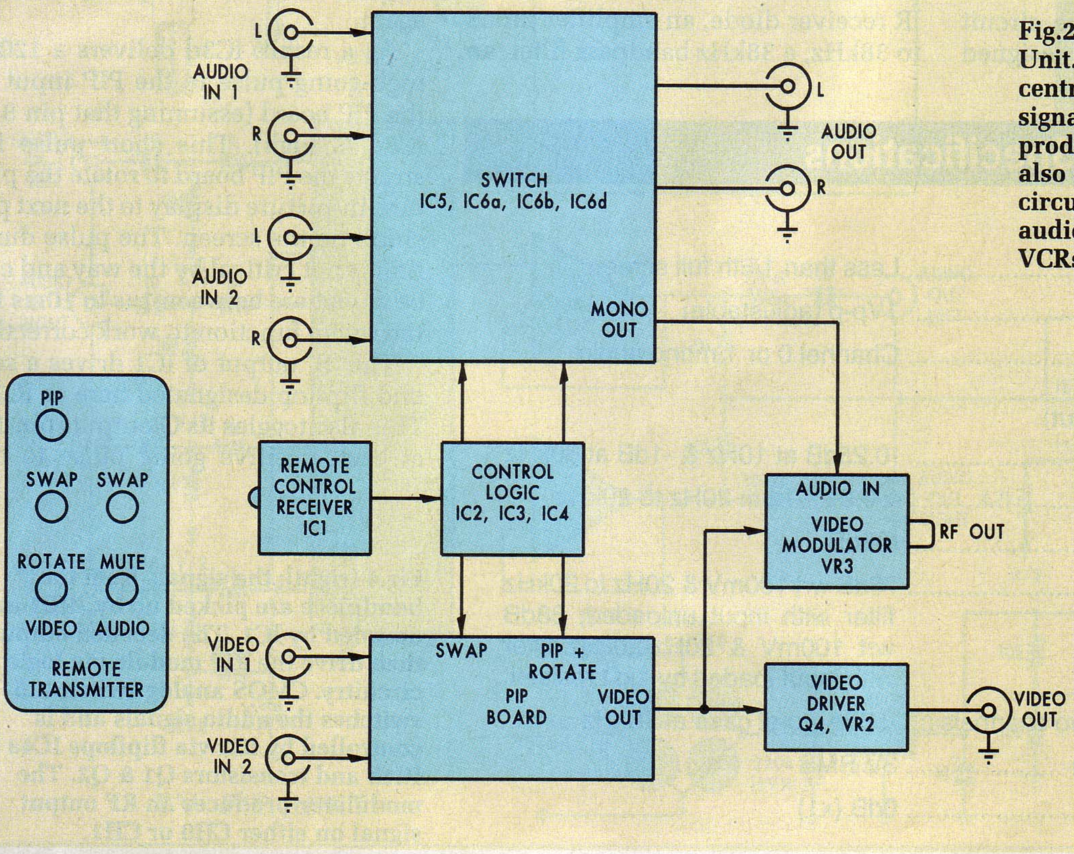


Fig.2: block diagram of the PIP Unit. The PIP board (bottom, centre) processes the video signals from the two VCRs and produces a single PIP signal. It also controls the logic circuitry which switches the audio signals from the two VCRs.

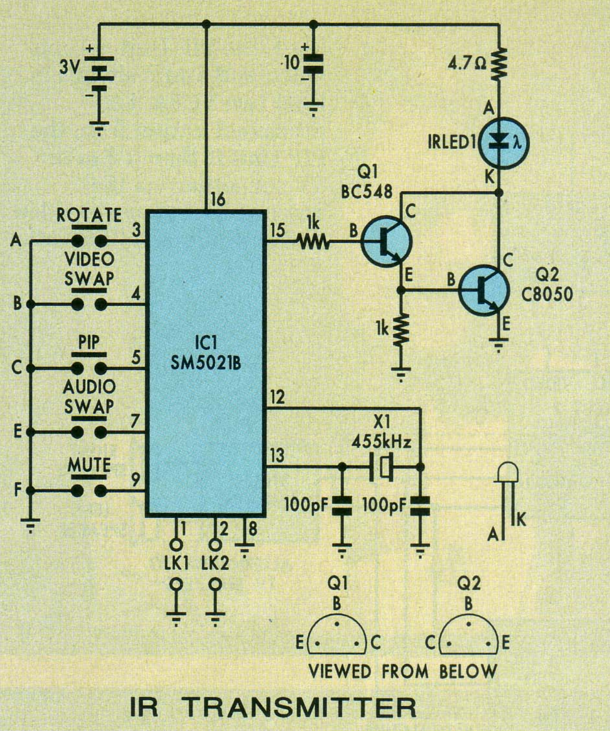


Fig.3 the circuit for the IR Transmitter. IC1 is an SM5021B encoder which outputs a unique code for each switch. This code gates a 38kHz carrier on and off and the output at pin 15 drives Darlington transistor pair Q1 & Q2. These in turn drive IRLED1.

avoid conflict with another remote control which uses the same device. Normally, these can both be left open for the default coding. Connecting either or both pins 1 & 2 of IC1 to ground will change the code.

Circuit details – PIP unit

Refer now to Fig.4 for the circuit details of the PIP Unit. It's designed around the PIP board which, as mentioned above, comes as a pre-built module.

Starting at the top lefthand corner, IRD1 picks up the signals from the handheld transmitter. This 3-terminal device is actually a bit more complicated than it looks. It contains an IR receiver diode, an amplifier tuned to 38kHz, a 38kHz bandpass filter, an automatic gain control (AGC) section and a detector. Its output is a digital pulse train identical to that generated by the transmitter but inverted.

Q1 is used to re-invert the signal, after which it is fed to pin 2 of decoder IC1 (SM5032B). The decoding links LK1 and LK2 must match those in the transmitter, to ensure compatibility.

IC1 has eight outputs (A-H) and these match the switches in the transmitter. In this circuit, however, we only use the A, B, C, E & F outputs which are all momentary action.

Pressing the ROTATE (A) switch on the transmitter will produce a high output on the 'A' output of decoder IC1. Similarly, pressing the other buttons on the transmitter produces highs on the other decoder outputs.

The 'C' output (PIP) of IC1 drives the clock input of flipflop IC2a. Each time 'C' goes high, IC2a's Q output (pin 1) toggles (low to high or high to low). When this output goes high, the output of Schmitt NAND gate IC3d goes low. This selects the picture-in-picture function for the PIP board.

The 'A' output (ROTATE) of IC1 is buffered by gates IC3a & IC3b. When the 'A' output goes high, the inputs to IC3c are pulled high via the .012μF capacitor and IC3c's output goes low. After about 120μs, the capacitor charges via its associated 10kΩ resistor and so IC3c's output goes high again.

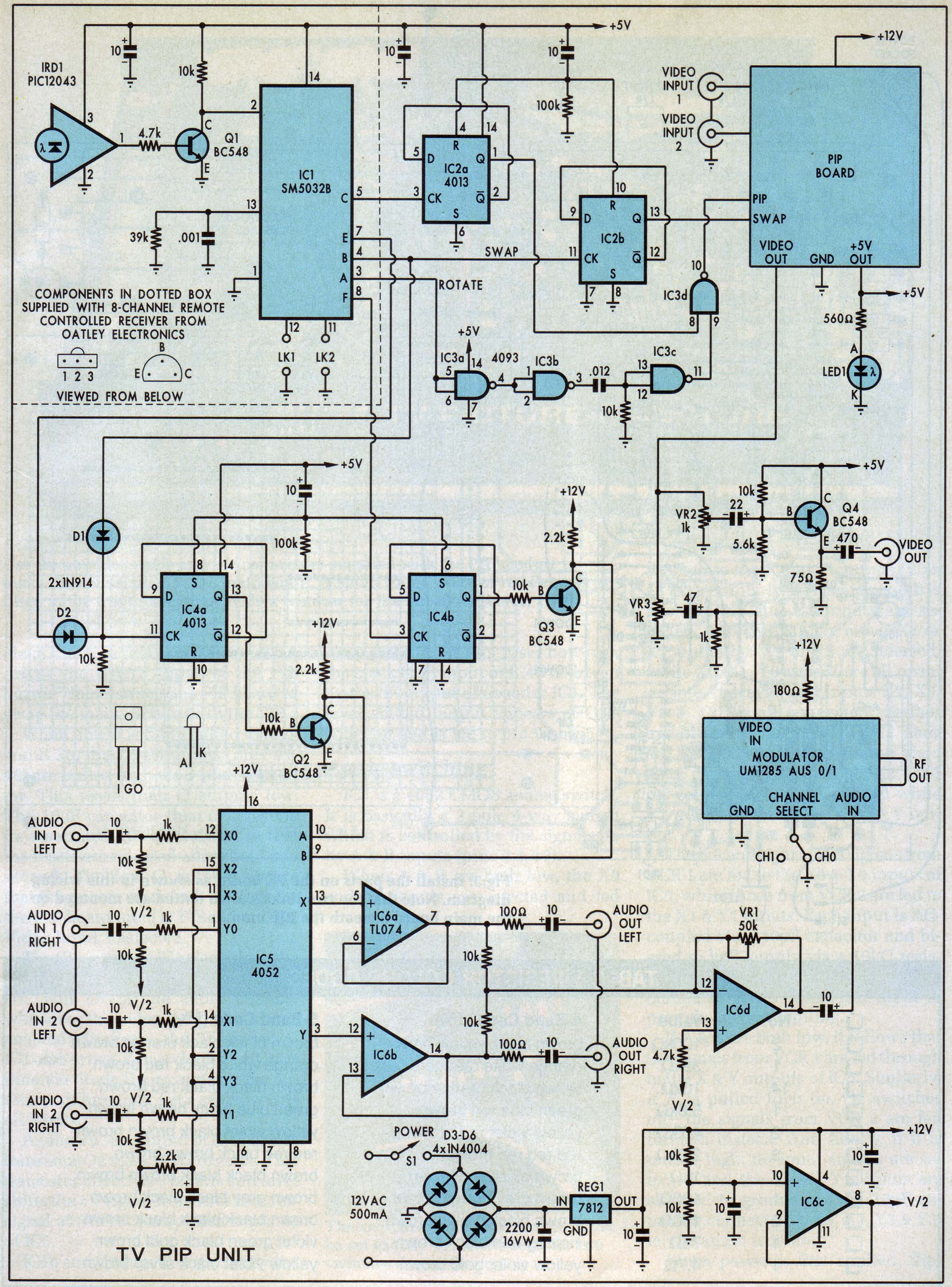
As a result, IC3d delivers a 120μs high-going pulse to the PIP input of the PIP board (assuming that pin 8 of IC3d is high). This short pulse instructs the PIP board to rotate the picture-in-picture display to the next position on the screen. The pulse duration is not critical by the way and can be anywhere between 1μs to 10ms for the rotate function to work correctly.

The 'B' output of IC1 drives a second flipflop designated here as IC2b. This also toggles its Q output (pin 13) at each positive going pulse to the

Specifications

Video	
Picture-in-picture size	Less than 1/6th full screen
Video output	1Vp-p (adjustable)
Modulator output	Channel 0 or 1 mono audio
Audio (wrt 100mV in or out)	
Frequency response	-0.25dB at 10Hz & -1dB at 60kHz
Total harmonic distortion	< 0.01% from 20Hz to 20kHz
Mute level	-63dB
Signal-to-noise ratio	78dB wrt 100mV & 20Hz to 20kHz filter with input unloaded; 88dB wrt 100mV & 20Hz-20kHz filter with input loaded by 1kΩ resistor
Crosstalk between any two channels	-56db worst case at 10kHz
Maximum signal handling	3V RMS
Signal gain	0dB (x1)

Fig.4 (right): the signals from the handpiece are picked up by IRD1 and decoded by IC1. The decoded outputs then drive the PIP module via logic circuitry. CMOS analog switch IC5 switches the audio signals and is controlled by IC1 via flipflops IC4a & IC4b and transistors Q1 & Q2. The modulator produces an RF output signal on either CH0 or CH1.


IRD1
PIC12043
Q1
BC548
IC1
SM5032B
LK1
LK2
COMPONENTS IN DOTTED BOX
SUPPLIED WITH 8-CHANNEL REMOTE
CONTROLLED RECEIVER FROM
OATLEY ELECTRONICS
VIEWED FROM BELOW
IC2a
4013
IC2b
SWAP
ROTATE
IC3a
4093
IC3b
IC3c
IC3d
VIDEO
INPUT
1
VIDEO
INPUT
2
PIP
BOARD
PIP
SWAP
VIDEO
OUT
GND
+5V
OUT
LED1
VR2
VR3
Q4
BC548
VIDEO
OUT
D1
2x1N914
D2
IC4a
4013
IC4b
Q3
BC548
Q2
BC548
I GO
VIDEO
IN
MODULATOR
UM1285 AUS 0/1
RF
OUT
GND
CHANNEL
SELECT
AUDIO
IN
CH1
CH0
AUDIO
IN 1
LEFT
AUDIO
IN 1
RIGHT
AUDIO
IN 2
LEFT
AUDIO
IN 2
RIGHT
IC5
4052
IC6a
TL074
IC6b
AUDIO
OUT
LEFT
AUDIO
OUT
RIGHT
VR1
50k
IC6d
POWER
S1
D3-D6
4x1N4004
12VAC
500mA
2200
16VW
REG1
7812
IN
OUT
GND
IC6c
TV PIP UNIT

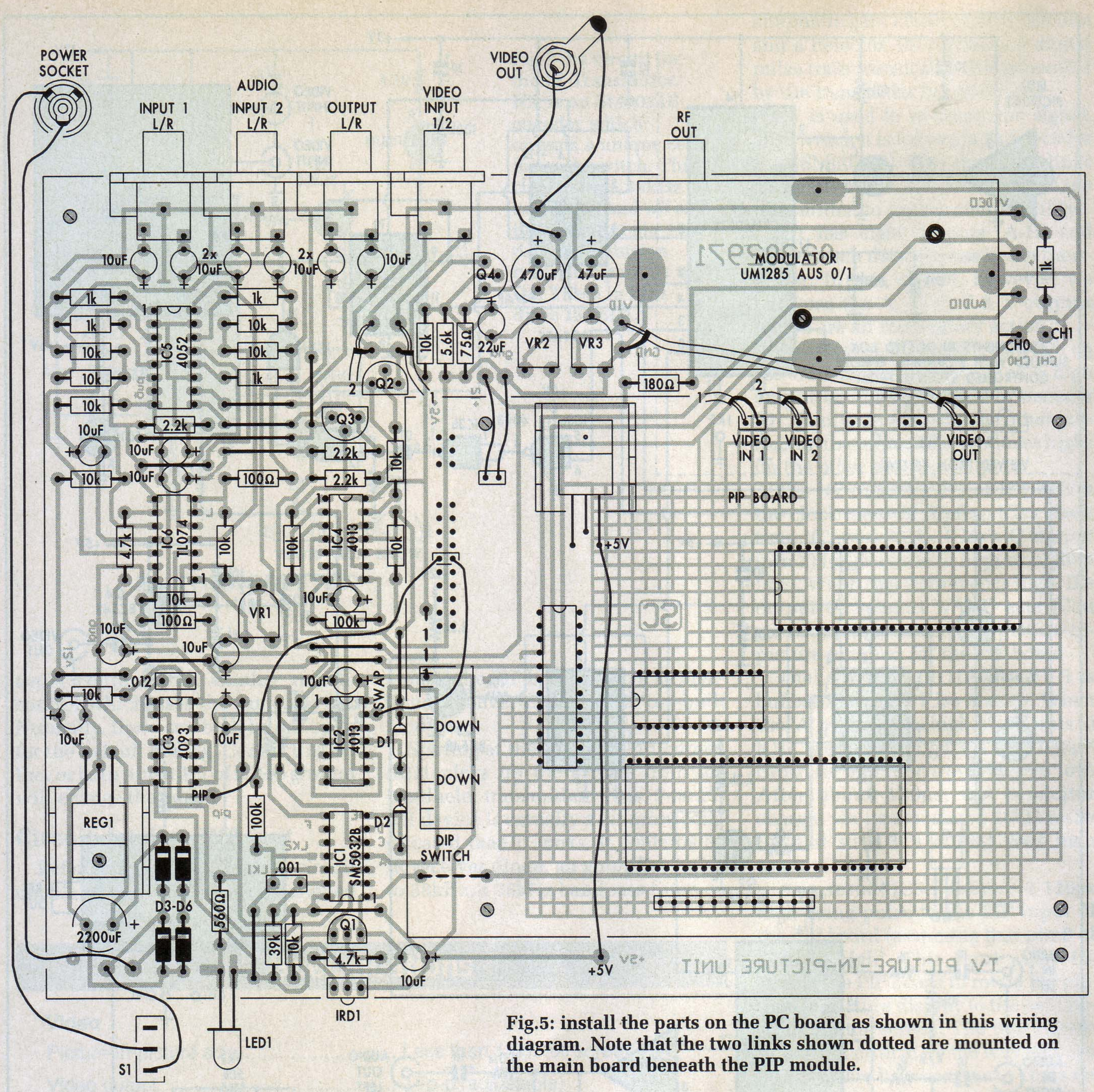
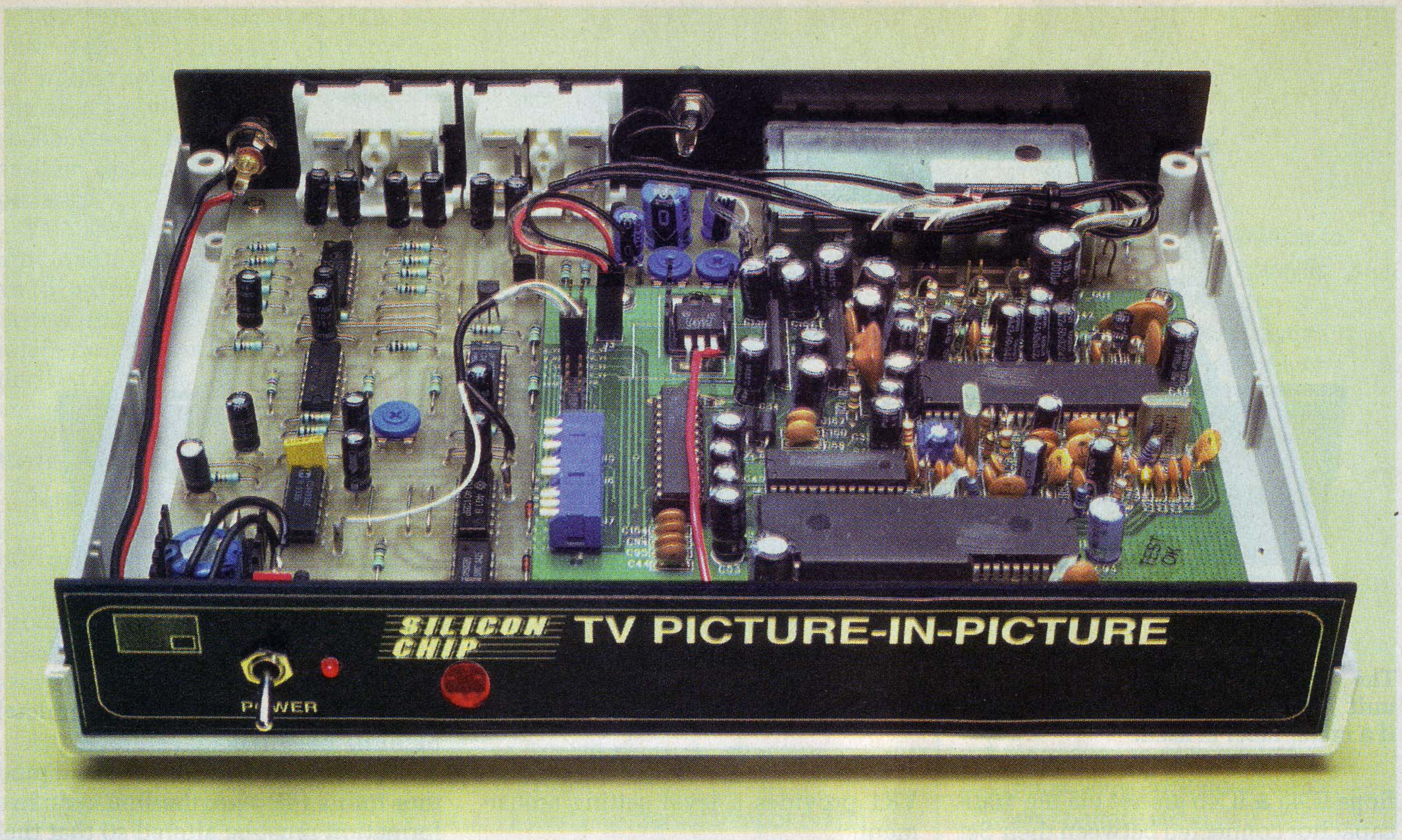


Fig.5: install the parts on the PC board as shown in this wiring diagram. Note that the two links shown dotted are mounted on the main board beneath the PIP module.

TABLE 1:RESISTOR COLOUR CODES

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	39kΩ	orange white orange brown	orange white black red brown
❑	14	10kΩ	brown black orange brown	brown black black red brown
❑	1	5.6kΩ	green blue red brown	green blue black brown brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	3	2.2kΩ	red red red brown	red red black brown brown
❑	7	1kΩ	brown black red brown	brown black black brown brown
❑	1	180Ω	brown grey brown brown	brown grey black black brown
❑	2	100Ω	brown black brown brown	brown black black black brown
❑	1	75Ω	violet green black brown	violet green black gold brown
❑	1	4.7Ω	yellow violet gold brown	yellow violet black silver brown



Use the shielded cable and the connectors supplied with the PIP module to make the connections to the main board. A small round piece of red Perspex is fitted to the front panel to provide a window for the infrared receiver (IRD1).

clock input. In this case, the Q output drives the SWAP input of the PIP board. This instructs the PIP board to swap the main picture with the PIP.

When power is first applied to IC2a and IC2b, their reset inputs (pins 4 & 10) are pulled high via a 10μF capacitor. This resets their Q outputs low. The 10μF capacitor then charges via its associated 100kΩ resistor, so that the resets are released after about one second. The low Q outputs ensure that the power on default settings for the PIP board are: (1) PIP off; and (2) Video Input 1 selected.

The 'B' output of IC1 also drives the clock input of flipflop IC4a, via diode D1. This swaps the audio channel whenever the video swap function is enabled. Similarly, the 'E' output of IC1 also drives IC4a's clock input, this time via diode D2, to perform the audio swap function. Let's see how this all works.

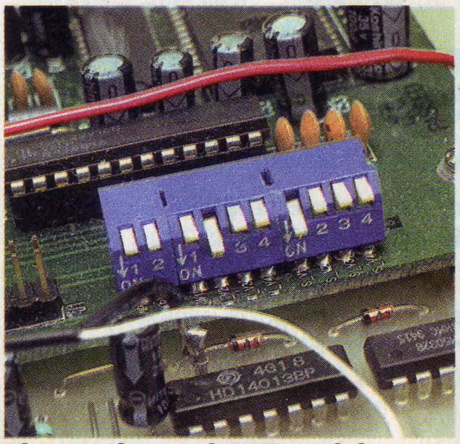
As shown, the output of IC4a drives transistor Q2 via a 10kΩ resistor. This transistor effectively inverts and level shifts the 5V signal from IC4a to a 12V signal which is then applied to pin 10 of IC5.

IC4b and Q3 function in exactly the same fashion. In this case, however, the clock (CK) input of IC4b is driven by the 'F' output of decoder IC1. The level shifted output appears at Q3's collector and is fed to pin 9 of IC5.

Audio switching

IC5 is a 4052 CMOS analog switch. It is basically a 2-pole 4-way switch which is controlled by the signals on its A & B inputs (pins 9 & 10).

When A & B are both low, the X0 and Y0 inputs are selected and fed



The switches on the PIP module must be set exactly as shown here; ie, two switches down, the rest up.

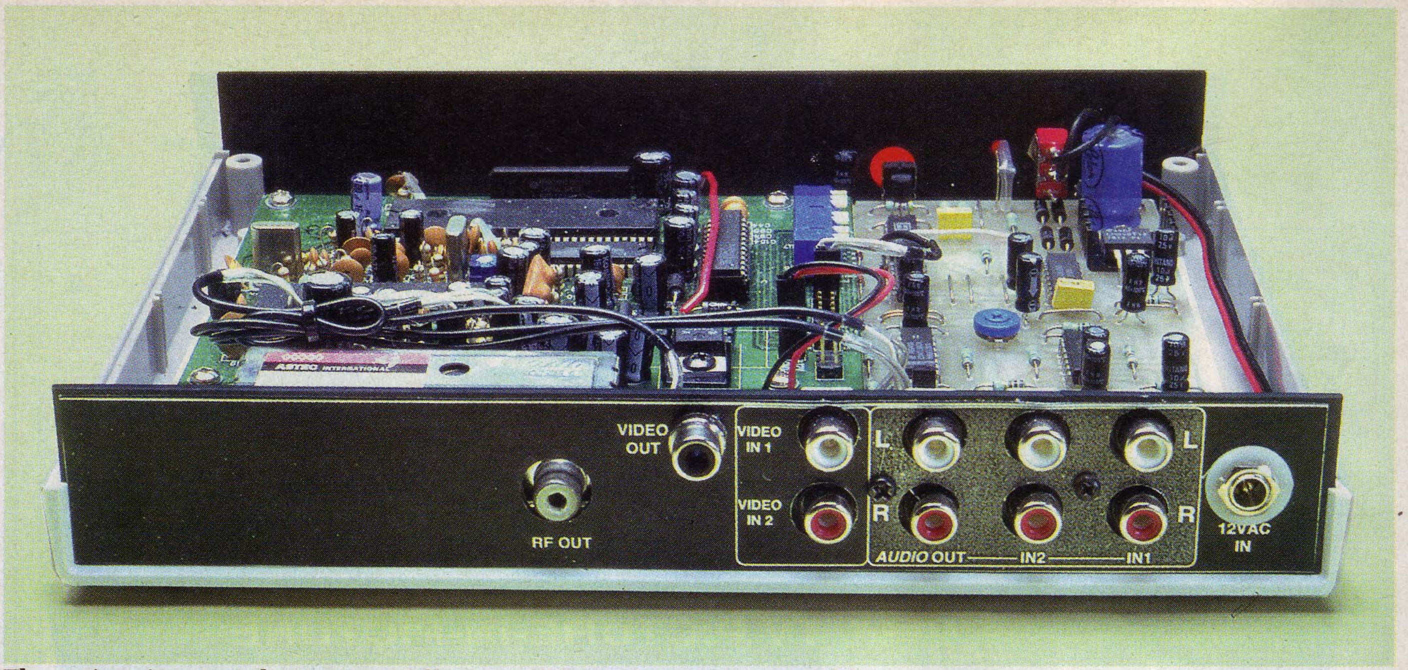
through to the X and Y outputs (pins 13 & 3). Similarly, if A is high and B is low, the X1 and Y1 inputs are selected. And if B is high, either X2 or X3 and either Y2 or Y3 are selected, while X0, X1, Y0 and Y1 are all open.

Note, however, that inputs X2, X3, Y2 & Y3 are all connected together and biased to half supply (V/2). They are also AC-coupled to ground via a 10μF capacitor. If B is high, X2 & X3 are connected to the X output, while Y2 & Y3 are connected to the Y output.

The left and right audio signals from VCR 1 are fed to the X0 & Y0 inputs of IC5, while those from VCR 2 are fed to the X1 & Y1 inputs. Each input is AC-coupled via a 10μF capacitor and biased to half supply via a 10kΩ resistor. In addition, a 1kΩ resistor is included in series with each input to provide current limiting.

If A & B are both low, it follows that the signals from VCR 1 are fed through to the X & Y outputs of IC5. Similarly, if A is pulled high (ie, Q2 switches off), the signals from VCR 2 are fed through instead. And finally, if B is pulled high, no input signals are selected and the X and Y outputs are shunted to ground via the 10μF capacitor connected to X2, X3, Y2 & Y3; ie, the audio is muted.

When power is first applied, flip-



The various inputs and outputs are all run via RCA sockets at the rear of the unit. Note that the power supply socket must be insulated from the rear panel if a metal label is used.

flops IC4a & IC4b are set via the 10μF capacitor connected between their Set inputs (pins 8 & 6) and the +12V supply rail. This sets the Q outputs high and the collectors of Q2 and Q3 low. Thus at power up, the audio signals from VCR 1 are selected and the muting is off.

The left & right audio signals from IC5 are buffered using op amps IC6a and IC6b. The outputs from these stages appear at pins 7 & 14 respectively and are fed to the output sockets via 100Ω resistors and 10μF capacitors.

In addition, the left and right channels are mixed via 10kΩ resistors and fed to amplifier stage IC6d. Its pin 14 output in turn drives the audio input of the modulator via a 10μF capacitor. VR1 provides a level setting adjustment.

PIP board

While we do not propose to describe in detail how the PIP board works, we can give a precis of its operation. A video signal consists of luminance (brightness) and chrominance (colour) information, mixed with colour burst and line and frame sync pulses.

The line sync pulses indicate the beginning and end of each line in the picture; ie, from the far left to the far right of the TV screen. The video luminance and colour signals are present between these sync pulses and produce the picture information in each line. The frame sync pulses indicate the beginning and end of a complete picture.

In order to shrink the full-sized picture into a PIP size, the line sync information must be altered so that the picture is positioned on a different part of the screen. This is done in two ways. First, the line length for the PIP is reduced by discarding some of the video information so that it fits into a smaller space. And second, the number of lines is reduced to decrease the picture height.

The way in which this is done is rather complicated. First, the required information for each video frame is sampled using a fast A-D converter and stored in a dual-port RAM. The term "dual-port" simply means that we can simultaneously store information in memory and retrieve it, without halting either process. The stored video information is then retrieved from the memory at the appropriate rate, reconverted to analog format and inserted into the main (full-screen) video signal.

Basically, all we are doing is substituting PIP video information over part of each line for the main picture, until the PIP is complete. Because of this, the information retrieved from the RAM does not contain vertical or horizontal sync pulses, since these would upset the operation of the main picture.

The video output from the PIP board goes to two separate circuits: (1) a buffer stage based on transistor Q4; and (2) to the modulator.

Where To Buy The Parts

The major parts for this design are available as follows:

(1) PIP module plus main PC board: Av-Comm Pty Ltd, PO Box 225, Balgowlah, NSW 2093. Phone (02) 9949 7417; Fax (02) 9949 7095. Price – $209 plus $10 p&p. Please quote Cat. K1400 (available end of May 1997).

(2) Complete IR transmitter kit plus all IR receiver parts (please specify no PC board for receiver when ordering): Oatley Electronics, PO Box 89, Oatley, NSW 2223. Phone (02) 9584 3563; Fax (02) 9584 3561. Price $30 plus $3.50 p&p.

(3) Astec UM1285AUS 0/1 video modulator: Dick Smith Electronics (Cat. K-6043).

VR2 sets the video level into the base of Q4. This transistor is wired as an emitter follower and the resulting signal is coupled to the video output socket via a 470µF capacitor. The 75Ω emitter resistor sets the output impedance.

VR3 sets the input level for the video modulator. This modulator provides an RF output on either channel 0 or 1, depending on the channel select linking option. Power to the modulator is derived from the +12V rail via a 180Ω current limiting resistor.

Power supply

Power for the circuit is derived from a 12VAC plugpack. It's output is fed to bridge rectifier D3-D6 and filtered with a 2200µF capacitor to derive a 16VDC (nom.) supply. This is then applied to 3-terminal regulator REG1 which provides a 12V supply rail for the PIP board and ICs 5 & 6.

A 3-terminal regulator on the PIP board provides a separate +5V rail and this is used to power IRD1 and ICs 1-4. It also drives a LED power indicator via a 560Ω resistor.

Finally, a half-supply voltage is derived from a voltage divider consisting of two 10kΩ resistors. This is buffered by unity gain amplifier stage IC6c and the resulting V/2 output used to bias the audio input signals to IC5.

Construction

The parts for the PIP Unit are mounted on a PC board coded 02302971 and measuring 197 x 154mm. This board accommodates the preassembled PIP module, the modulator and all the support circuitry. You can buy the PIP module and the PC board from Av-Comm Pty Ltd, while the handheld transmitter and receiver parts are available from Oatley Electronics. Dick Smith Electronics stocks the specified video modulator.

Fig.5 shows the parts layout on the PC board. Before mounting any of the parts, check the board carefully for shorts between the tracks and for breaks in the copper pattern. You should also check that the mounting holes for the PIP board and for REG1 are drilled to 3mm and that the mounting holes for the modulator earth lugs are correct.

Begin the assembly by installing the links and the resistors. Note that two of the links are shown dotted, to indicate that they go under the PIP mod-

PARTS LIST

1 PC board, code 02302971, 197 x 154mm
2 self-adhesive labels for front & rear panels, 215 x 34mm
1 remote control transmitter label, 31 x 63mm
1 plastic case, 225 x 165 x 40mm (Jaycar Cat. HB5972)
1 PIP board (from Av-Comm)
1 video modulator, Astec UM1285AUS 0/1 (DSE Cat. K-6043)
1 12VAC 500mA plugpack
2 2 x 2-way PC-mount RCA sockets (Altronics P-0211)
1 RCA panel-mount socket
1 DC panel socket to suit plugpack
1 SPDT toggle switch (S1)
1 TO220 heatsink, 19 x 19 x 6mm
1 50kΩ horizontal trimpot (VR1)
2 1kΩ horizontal trimpots (VR2,VR3)
1 400mm length of 0.8mm tinned copper wire
1 500mm length of hook-up wire
4 self-tapping screws to secure board to case
4 3mm dia. x 9mm screws & nuts
4 5mm spacers
1 3mm dia. x 6mm screw and nut
1 8mm ID grommet (to insulate DC socket)
15 PC stakes
1 10mm dia. x 3mm red Perspex for IR sensor window

Semiconductors
2 4013 dual-D flipflops (IC2,IC4)
1 4093 quad Schmitt NAND gate (IC3)
1 4052 dual 1-to-4 analog multiplexer/demultiplexer (IC5)
1 TL074, LF354 quad op amp (IC6)
1 7812 12V 3-terminal regulator (REG1)
3 BC548 NPN transistors (Q2, Q3, Q4)
2 IN914, 1N4148 signal diodes (D1,D2)
4 1N4004 1A diodes (D3-D6)
1 3mm LED (LED1)

Capacitors
1 2200µF 16VW PC electrolytic
1 470µF 16VW PC electrolytic
1 47µF 16VW PC electrolytic
1 22µF 16VW PC electrolytic
14 10µF 16VW PC electrolytic
1 .012µF (12n or 123) MKT polyester

Resistors (0.25W 1%)

2 100kΩ	5 1kΩ
13 10kΩ	1 180Ω
1 5.6kΩ	2 100Ω
1 4.7kΩ	1 75Ω
3 2.2kΩ	

8-Channel IR Transmitter
1 Magnavox remote control handpiece (includes IRLED and battery clips)
1 455kHz resonator (X1)
1 PC board
2 AAA cells
2 PC stakes

Semiconductors
1 SM5021B encoder (IC1)
1 BC548 NPN transistor (Q1)
1 C8050 NPN transistor (Q2)

Capacitors
1 10µF 16VW PC electrolytic
2 100pF (100p or 101) ceramic

Resistors

2 1kΩ	1 4.7Ω

8-Channel IR Receiver
1 SM5023B remote control receiver (IC1)
1 BC338 NPN transistor (Q1)
1 PIC12043 infrared receiver (IRD1)

Capacitors
1 10µF 16VW PC electrolytic
1 .001µF (1n0, 102 or 1000p) ceramic

Resistors

1 39kΩ	1 4.7kΩ
1 10kΩ	

Fig.6: this full-size artwork can be used as a drilling template for the front panel.

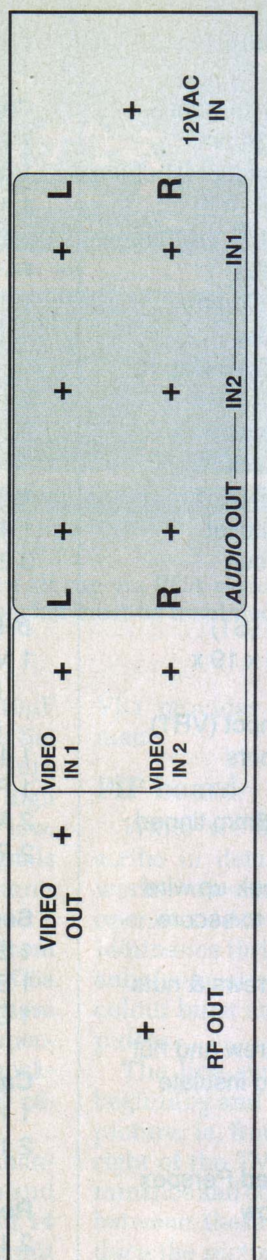


Fig.7: the full-size artwork for the rear panel. It can be photocopied and affixed to the rear panel using double-sided adhesive tape.

Fig.8: this is the full-size front panel artwork for the hand-held transmitter.

ule – don't forget these. Table 1 lists the resistor colour codes but it is also a good idea to check each value using a digital multimeter, just to make sure.

The diodes can be mounted next, taking care to ensure that they are oriented correctly. Note that two types are used on the main PC board: (1) the 1A 1N4004s which have a black body; and (2) the smaller 1N914s which are usually orange in colour.

The 14 PC stakes can now be installed on the PC board, followed by the ICs. Take care with the orientation of each IC and check that the correct type has been installed at each location before soldering. Note particularly that IC1 & IC6 are oriented differently to the other ICs.

The LK1 and LK2 linking options for IC1 can be left open circuit, unless you already have an identical IR remote control with the same coding.

The four transistors are all BC548 types and these must be oriented exactly as shown. REG1 is mounted horizontally, with its leads bent at rightangles so that they pass through the PC board. It is fitted with a small heatsink and bolted to the PC board using a 3mm screw and nut.

The capacitors can now be installed, along with IRD1, LED1 and the trimpots. Be sure to orient IRD1 with its bubble-shaped lens towards the front. LED1 should be mounted at full lead length, so that it can later be bent over and pushed through its mounting hole in the front panel hole.

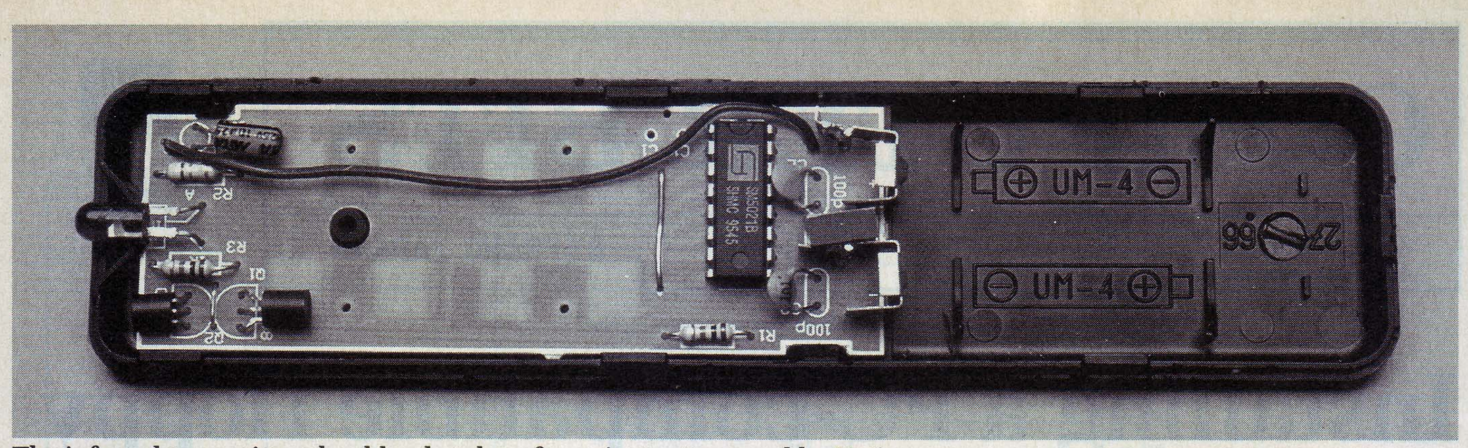
The two RCA socket sets must have their plastic locating pins removed before they are mounted. Remove these using sidecutters, then solder the RCA sockets in position, taking care to ensure that their bottom surfaces sit flush with the board.

The video modulator is mounted in the top righthand corner of the board. As shown, the unit is wired for channel 0. If you want channel 1, simply transfer the lead from the CH0 position to the CH1 position.

The PC board assembly can now be completed by mounting the PIP module. This board is mounted on 5mm spacers and secured using 3mm screws and nuts. Wire up the board using the supplied shielded leads and the red/black power lead. Don't forget to solder a length of hookup wire from the onboard 5V regulator output to the +5V PC stake on the main PC board.

Final assembly

The completed assembly is housed in a standard plastic instrument case measuring 225 x 165 x 40mm.



The infrared transmitter should only take a few minutes to assemble. Notice how the two transistors are bent over, so that they sit flat against the board. The board simply clips into position in the case.

Begin the case assembly by affixing the labels to the front and rear panels. This done, drill out the holes on the rear panel for the RCA sockets, the power socket and the RF OUT socket. The best way to go about this is to first drill small pilot holes and then carefully enlarge each hole to the correct size using a tapered reamer.

Moving now to the front panel, drill the holes for the power switch and its adjacent indicator LED. You will also have to drill a 10mm hole in the front panel in line with IRD1. We fitted a 10mm-dia. red Perspex window to this hole, rather than simply leave it open.

The various items can now all be mounted in position and the wiring completed as shown in Fig.5. Note that the PC board assembly is secured using self-tapping screws which go into integral pillars in the base of the case. Two small self-tapping screws are also used to secure the stereo RCA sockets to the rear panel.

Important: if a metal label is used on the rear panel (eg, Dynamark), be sure to insulate the power socket from the panel. This can be done by stripping back the label from around the mounting hole and then fitting a large insulating washer under the mounting nut. If this is not done, the metal label will short one side of the 12VAC power supply to ground.

Transmitter assembly

Very little work is required to assemble the IR transmitter, as Fig.9 shows. It's mainly a matter of soldering a few parts to the transmitter board. Take care to ensure that the infrared LED is installed with the correct polarity and note that Q1 is a BC548 while Q2 is a C8050.

After that, all you have to do is attach the label to the transmitter case and cut out the holes for the switch pads, as marked. You will also have to cut off the switch pads on the rubber membrane that were originally intended for the volume and CD selections.

The two halves of the case are simply clipped together after installing the two 1.5V AAA cells.

Testing

Now for the smoke test but first go back over your work carefully and check for possible wiring errors. In particular, check that all components are correctly oriented and that the correct part has been used at each location.

This done, apply power and check that there is +12V at the output of REG1 and +5V at the output of the regulator on the PIP board. If these voltages are OK, switch off and set two of the DIP switches on the PIP module to the down position, as shown on Fig.5. These select the video sources for the main and PIP display.

It's now simply a matter of connecting the unit as shown in Fig.1 and testing it for correct operation. Remember to tune the TV set to the appropriate channel (either CH0 or CH1), if you are using the RF output from the PIP Unit. Of course, this step will not be necessary if you are feeding the audio/video outputs from the PIP Unit to the TV set.

Now apply power and check that the signal applied to INPUT 1 appears on the screen as the main picture. At this stage, there should be no PIP. If this is correct, adjust VR3 to obtain the correct contrast range and to prevent overmodulation (assuming the RF output is being used). If the direct video output is being used, adjust VR2 for correct contrast instead. VR1 is adjusted for a normal sound level.

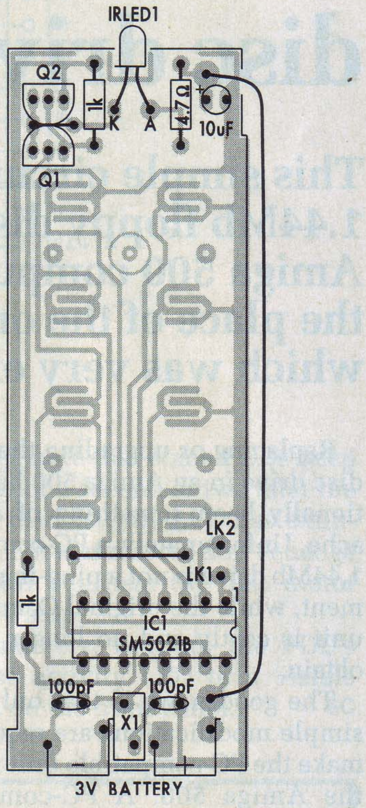
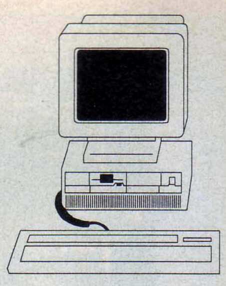


Fig.9: take care with the orientation of the infrared LED and don't confuse transistors Q1 & Q2 when installing the parts on the transmitter board. The two transistors are installed flat against the board as shown in the photo at the top of the page.

You can now check the remote control. Select PIP and check that a small picture corresponding to the second video input appears in the lower righthand corner of the screen. If it does, check that the ROTATE and video SWAP functions work – the sound should follow the main picture. Finally, check that the audio SWAP and MUTING functions work. **SC**



BY FRANC ZABKAR

Installing a PC-compatible floppy disc drive in an Amiga 500

This simple circuit allows a PC-compatible 1.44Mb floppy disc drive to be used in an Amiga 500 computer. The new drive can take the place of the original Commodore unit which was very expensive.

Replacing or upgrading the floppy disc drive in an Amiga 500 has traditionally been something of a headache. Unfortunately, a PC-compatible 1.44Mb drive is not a plug-in replacement, while the original Commodore unit is costly and no longer easy to obtain.

The good news is that only a few simple modifications are required to make the PC-compatible unit work in the Amiga 500. A PC-compatible 1.44Mb drive can now be picked up for $50 or less, whereas the Commodore drive costs about $150. If the floppy drive in your Amiga 500 has died, you can save about $100 by substituting a PC-compatible unit.

Note, however, that you will not be able to use the greater capacity of the PC-compatible drive, unless a special software driver is installed. Instead, discs will still be formatted to the 880Kb Amiga standard (does anyone know where to obtain a suitable driver so that the full 1.44Mb capacity can be used?).

Drive differences

The main interfacing differences between the PC and Amiga floppy disc drives (FDDs) involve pins 34 and 2. These differences are as follows:

(1). Pin 34 on the PC is the DISKCHANGE output; on the Amiga, it is the READY output.

(2). Pin 2 on the PC is the LOW/HIGH DENSITY input; on the Amiga it is the DISKCHANGE output.

In addition, the PC's outputs are open collector and the corresponding inputs to the drive are pulled high at the drive itself. Furthermore, PC-compatible FDDs are set up as Drive 1 rather than Drive 0 as on the Amiga.

Basically, all we have to do to get the PC-compatible floppy drive to work in the Amiga is make an appropriate 34-way interface cable and add a simple logic circuit. This logic circuit is based on a 7438 TTL quad NAND gate (only two gates used) and is shown, along with the interface cable, in Fig.1.

The logic circuit is needed to simulate the READY signal that Amiga requires but which the PC floppy drive does not provide. Several pull-up resistors (2.2kΩ) are also required for the open collector outputs (see Fig.1).

Making the cable

The 34-way interface cable is made as follows:

(1). At the drive end of the cable, separate leads 10, 11 & 12 as a three-lead wide strip and twist this strip, PC fashion, through 180°. This step effectively transposes leads 10 & 12 when the headers are attached and serves to designate the FDD as Drive 0; ie, pin 10 on the Amiga header goes to pin 12 on the drive header and vice versa (note: the pin 11 connections are unaffected). Note that lead 1 of the cable is designated by a red colour stripe.

(2). Install a 34-way female IDC header at the drive end (pin 1 to the lead with the red stripe).

(3). At the Amiga 500 end, snap on a similar IDC header about 50mm from the end of the cable. This 50mm-long free end is used to make the connections to the logic circuitry.

(4). At the drive end, carefully separate and cut lead 2 and peel it back until its end is just over half-way down the cable. Similarly, at the Amiga end but working from the drive side of the header (important), separate and cut lead 34 and peel it back until it reaches the end of lead 2.

(5). Strip the two lead ends, slip some heatshrink tubing over one of them, and solder the two leads together (ie, solder lead 2 to lead 34). Push the heatshrink tubing over the join and carefully shrink it down with a hot-air gun.

(6). Assemble the logic circuit on a small piece of Veroboard or similar and connect this to the 50mm of trailing cable at the Amiga end. You only need to connect leads 2, 8, 10, 26, 28, 30 & 34 to the logic circuit – the remaining leads can be cut off flush with the end of the header.

(7). Connect a power cable consisting of two leads (+5V, GND) to the logic board. Terminate the other end of this cable in a 3-pin header (+5V, GND, key) somewhere on the Amiga PC board (choose your own spot).

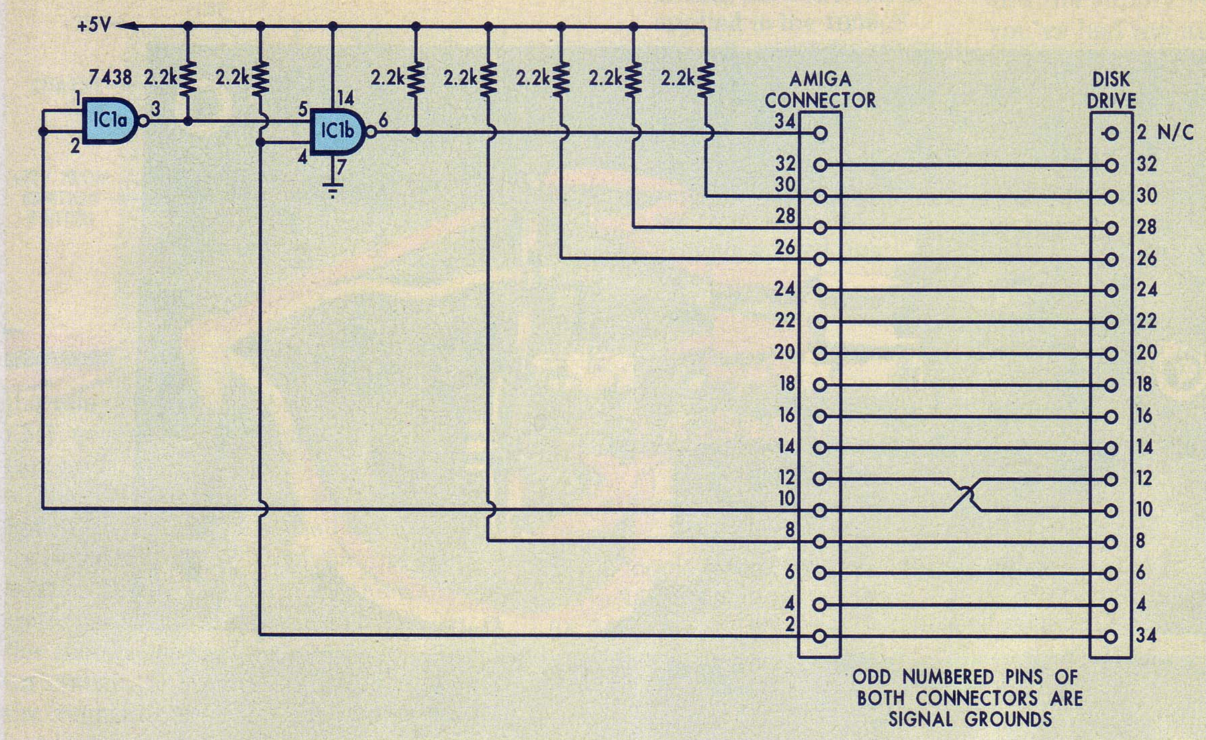


Fig.1: the interface circuit consists of a couple of NAND gates plus a modified drive connector cable.

Alternatively, you can hardwire the supply leads to the appropriate terminals inside the Amiga.

Mechanical arrangement

The mechanical arrangement is reasonably straightforward. Note that you will have to remove the plastic facia from the front of the drive and that you may need to pack the standoffs with washers to raise the drive to the correct height.

Depending on the arrangement, it may also be necessary to cut a hole in the side of the Amiga's cover to gain access to the FDD's disc eject lever. This lever may also have to be extended by some suitable means.

Finally, note that some FDDs keep spinning for a second or two after the Amiga's disc activity LED has extinguished. For this reason, don't change discs until you hear the disc motor come to a stop.

Alternatively, re-route the FDD's own disc activity LED to a visible position on the front panel. **SC**

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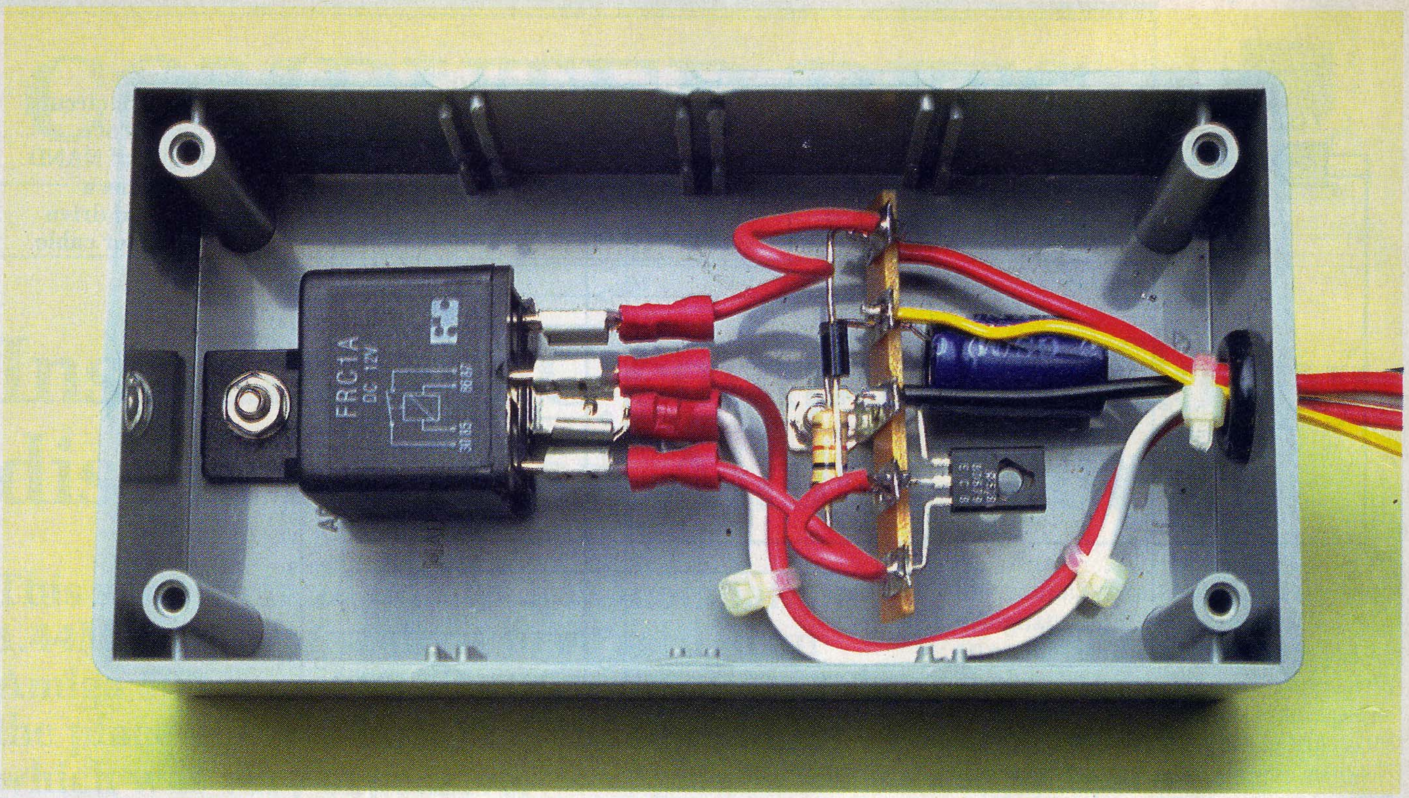


Teeny Timer: a low-tech timer for your car

There are plenty of applications in a car where a simple timer is required. This one doesn't use any ICs or even a PC board. It just uses a transistor, a capacitor, a relay and very little else. You could wire it up in almost no time at all and get delays of up to 30 seconds.

By LEO SIMPSON

This simple circuit came about because one of our readers wanted a timer for his water-cooled turbo intercooler. The timer was to be used to control an electric water pump and was to operate for a set time (seven seconds) each time after it was switched off. No doubt you can come up with a dozen other uses.

Now we could have come up with a fancier design using an IC such as a 555 timer. But that would have required a PC board and this reader just doesn't feel at home with ICs and PC boards. He also wanted the timer to operate in the engine bay and that ruled out consumer versions of the 555 or other timer ICs since their maximum operating temperature is only 70°C.

OK, we thought, "how do we come up with a simple timer, not using an IC and the absolute minimum of parts?" Oh, that was the other requirement: he didn't want a lot of parts in it because he gets confused when soldering them up! He's a pretty demanding customer, this one.

Anyway, we put the feet up on the desk, thought of faraway places, anything but timers really and finally this idea popped into the vacuum: "use a transistor". The result you can see in the circuit of Fig.1.

How it works

The heart of the Teeny Timer is a Darlington NPN transistor, Q1. When current is fed to its base via the 10kΩ resistor, the transistor is turned on and the relay is actuated to operate whatever you want. The diode across

Top of page: the Teeny Timer uses one Darlington transistor, a 1000µF capacitor and not a lot else to provide delays of about 38 seconds. A bigger capacitor would give a longer delay. Note that the circuit is wired on low-tech tagboard.

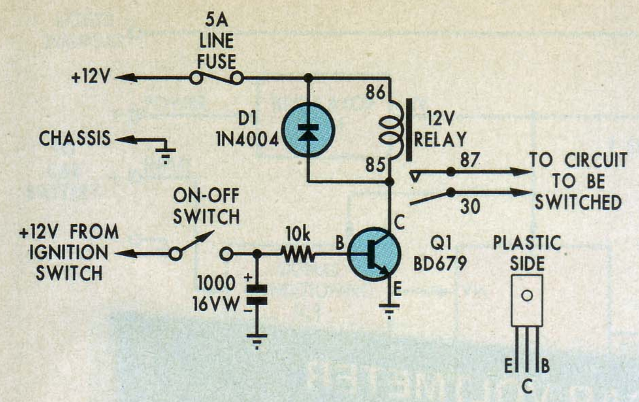


Fig.1: when switch S1 is closed, the +12V rail is applied to the 1000μF capacitor and the 10kΩ base resistor of the transistor, to turn the relay on. When switch S1 is opened, the 1000μF capacitor discharges via the 10kΩ base resistor to provide a fixed time delay.

the relay is there to absorb the back-EMF generated by the relay when it turns off.

The circuit operates as follows. When switch S1 is closed, it feeds +12V to the 1000μF capacitor and the 10kΩ resistor. This turns on the transistor and operates the relay. When the switch opens, the 1000μF capacitor continues to feed bias current to the transistor and so the relay stays on until the capacitor is substantially discharged.

There's not much more to it than that. The +12V supply is fed via an in-line fuse.

Varying the delay

The time delay can be varied by varying the size of the capacitor. On our version, the 1000μF capacitor gave a delay of about 38 seconds. 470μF would give about 17 seconds; 220μF about seven seconds; 100μF would give about four seconds and anything smaller you wouldn't bother about. Longer delays could be obtained by using bigger capacitors. For example, 2200μF should give about one minute 10 seconds while 4700μF should give about three minutes.

The actual delays will depend on the capacitor tolerance, the gain of the transistor, the ambient temperature and the supply voltage and whether you've had too much to drink lately. Not precise enough for you? Hey, this is a low-tech, low-cost design.

PARTS LIST

- 1 12V automotive relay (see text)
- 1 SPST toggle switch (S1)
- 1 inline 3AG fuseholder
- 1 5A 3AG fuse
- 1 plastic utility case, 130 x 68 x 42mm
- 1 BD679 or BD682 NPN Darlington transistor (Q1)
- 1 1N4004 silicon diode (D1)
- 1 1000μF 16VW electrolytic capacitor (see text for value)
- 1 10kΩ 0.25W resistor
- 1 5-way tagstrip
- 1 grommet
- 1 screw and nut to suit relay

Miscellaneous

Spade lug connectors, hook-up wire, solder.

Building it

No PC board! Whoa! Whaddya we do now?

In a throwback to the dim distant past, we built the circuit on a 5-way tagstrip. Fig.2 shows the wiring details. The relay is a standard automotive type with SPST contacts and rated at 20-30A. They can be purchased from any automotive parts outlet for about $11 or from Jaycar Electronics at $6.95. The relay is mounted with a single screw and nut, to the base of the plastic case.

You can either solder the connections directly to the relay or fit the wires with spade lug connectors, as we did.

Testing it

This is the easy part. Connect the circuit up to a battery or 12V supply and operate the switch. The relay should operate immediately. Then turn the switch off. The relay should stay closed for your desired delay time and then give a click to show that it has opened.

We mounted the whole lot in a plastic case and the leads all came in via a grommeted hole at one end. If you are going to mount the Teeny Timer in the engine bay of your car, keep it as far away from the hot spots as possible. Mount the case so that the wire entry hole is at the bottom, so that water splashes don't become a problem. **SC**

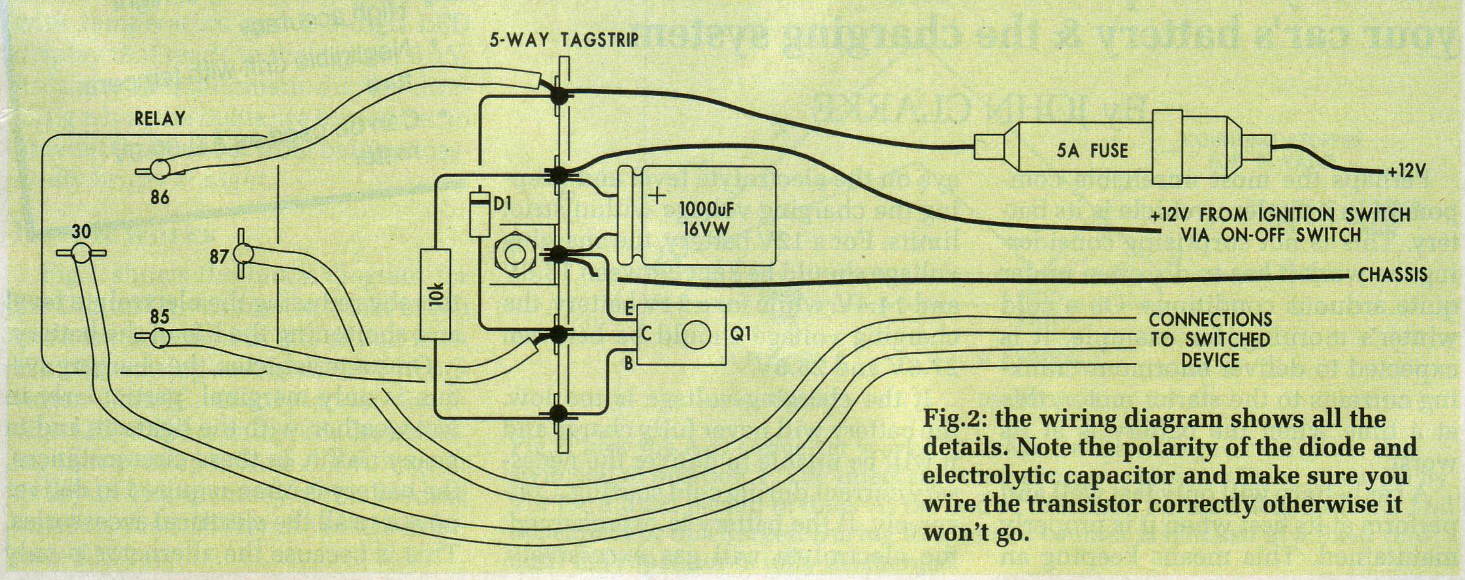


Fig.2: the wiring diagram shows all the details. Note the polarity of the diode and electrolytic capacitor and make sure you wire the transistor correctly otherwise it won't go.

A digital voltmeter for your car

Have you ever experienced that sinking feeling when your car won't start on those cold winter mornings? This digital voltmeter will let you keep tabs on the condition of your car's battery & the charging system.

By JOHN CLARKE

Main Features

- Compact size
- 3-digit LED readout
- 0.1V resolution
- Suitable for 12V and 24V batteries
- Leading "0" blanking
- Display dimming at night
- High accuracy
- Negligible drift with temperature
- Can be used as a 0-39.9V meter

Perhaps the most unreliable component in a modern vehicle is its battery. This is not surprising considering the work it has to do, often under quite arduous conditions. On a cold winter's morning, for example, it is expected to deliver enormous cranking currents to the starter motor, this at a time when the battery is at its worst.

A car battery will only last well and perform at its best when it is properly maintained. This means keeping an eye on the electrolyte level and keeping the charging voltage within strict limits. For a 12V battery, the charging voltage should be kept between 13.8V and 14.4V, while for a 24V battery, the charging voltage should be between 27.6V and 28.8V.

If the charging voltage is too low, the battery will never fully charge and it will be unable to deliver the necessary current during cold starting. Conversely, if the battery is overcharged, the electrolyte will gas excessively, thereby reducing the electrolyte level and shortening the life of the battery.

On some vehicles, the charging system is only marginal, particularly in wet weather, with the lights on and in heavy traffic. In these circumstances, the battery is often required to deliver power to all the electrical accessories. This is because the alternator is only

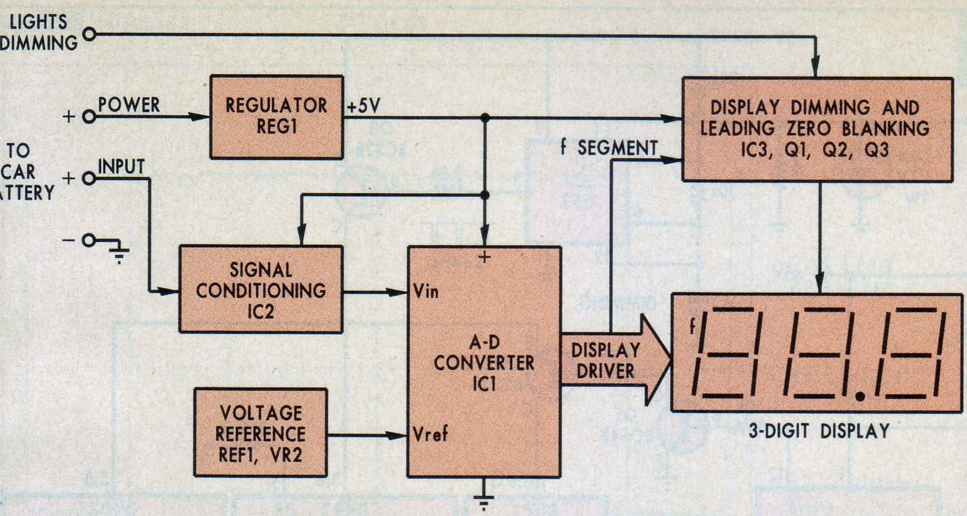


Fig.1: block diagram of the Digital Car Voltmeter. Most of the work is performed in IC1 which is an ICL7107 analog-to-digital (A-D) converter. This IC directly drives the 3-digit LED display and produces a reading that corresponds to the voltage at its input. The accuracy of this reading relies on the stability of voltage reference REF1.

driven by an idling engine and cannot adequately top up the battery.

Similarly, if you make lots of short trips, the battery might not have a chance to adequately charge between starts. The result – a flat battery and you're left stranded.

By fitting this digital voltmeter to your car, you can easily keep tabs on the condition of the battery and the charging circuit. If the battery voltage consistently reads low, for example, then either the battery is on the way out or the charging system is not working correctly. Either way, it's time to take action.

Conversely, if the battery voltage is always high, then the battery is being overcharged, as can easily happen if the regulator fails. This can not only damage the battery but, in severe cases, could also damage various electronic systems in the vehicle.

So there are good reasons for carefully monitoring the battery voltage in a car and this unit is ideal for the job. It boasts high accuracy, negligible drift with temperature and a 3-digit LED display that reads to the nearest 0.1V. It also features automatic display dimming when the lights are turned on, to prevent the readout from being excessively bright at night.

How it works

Fig.1 shows the block diagram for the Digital Car Voltmeter. Most of the work is performed in IC1 which is an ICL7107 analog-to-digital (A-D) converter. This IC directly drives the 3-digit LED display and produces a reading that corresponds to the voltage at its input. The accuracy of this reading relies on the stability of voltage reference REF1.

Fig.2(a) shows the basic method by which IC1 converts the analog input voltage to a digital display value. The two inputs, Vin and Vref, are fed to an integrator via switch S1 which selects between them.

To measure the voltage at Vin, S1 is switched to position 1. The integrator initially charges capacitor Cx at a rate set by Vin for a fixed period of time. The higher the voltage at Vin the higher the voltage at Vx at the end of this time period – see Fig.2(b). Note that slope 'A' in Fig.2(b) reaches a higher Vx voltage than slope 'B' because Vin is higher for 'A'.

At the end of the fixed time period, switch S1 selects the Vref value (position 2) which is opposite in polarity to Vin. Thus, capacitor Cx discharges at a fixed rate as set by Vref. During this "de-integrate" period, a counter is clocked at a fixed rate until the capacitor is fully discharged. The comparator then switches and the number in the counter is displayed.

This number is directly related to the voltage at Vin.

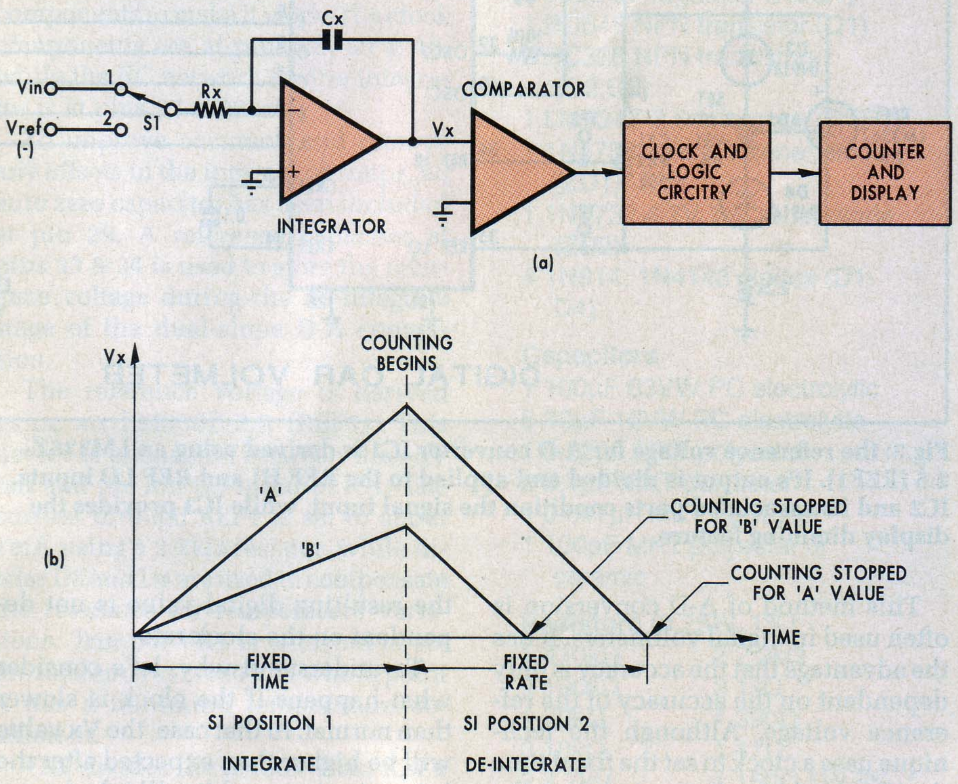


Fig.2: how the A-D converter works. To measure the voltage at Vin, S1 is first switched to position 1. The integrator then charges capacitor Cx at a rate set by Vin for a fixed period of time. At the end of this time, S1 is switched to Vref and the capacitor discharges. During this time, a counter is clocked at a fixed rate until the capacitor is fully discharged.

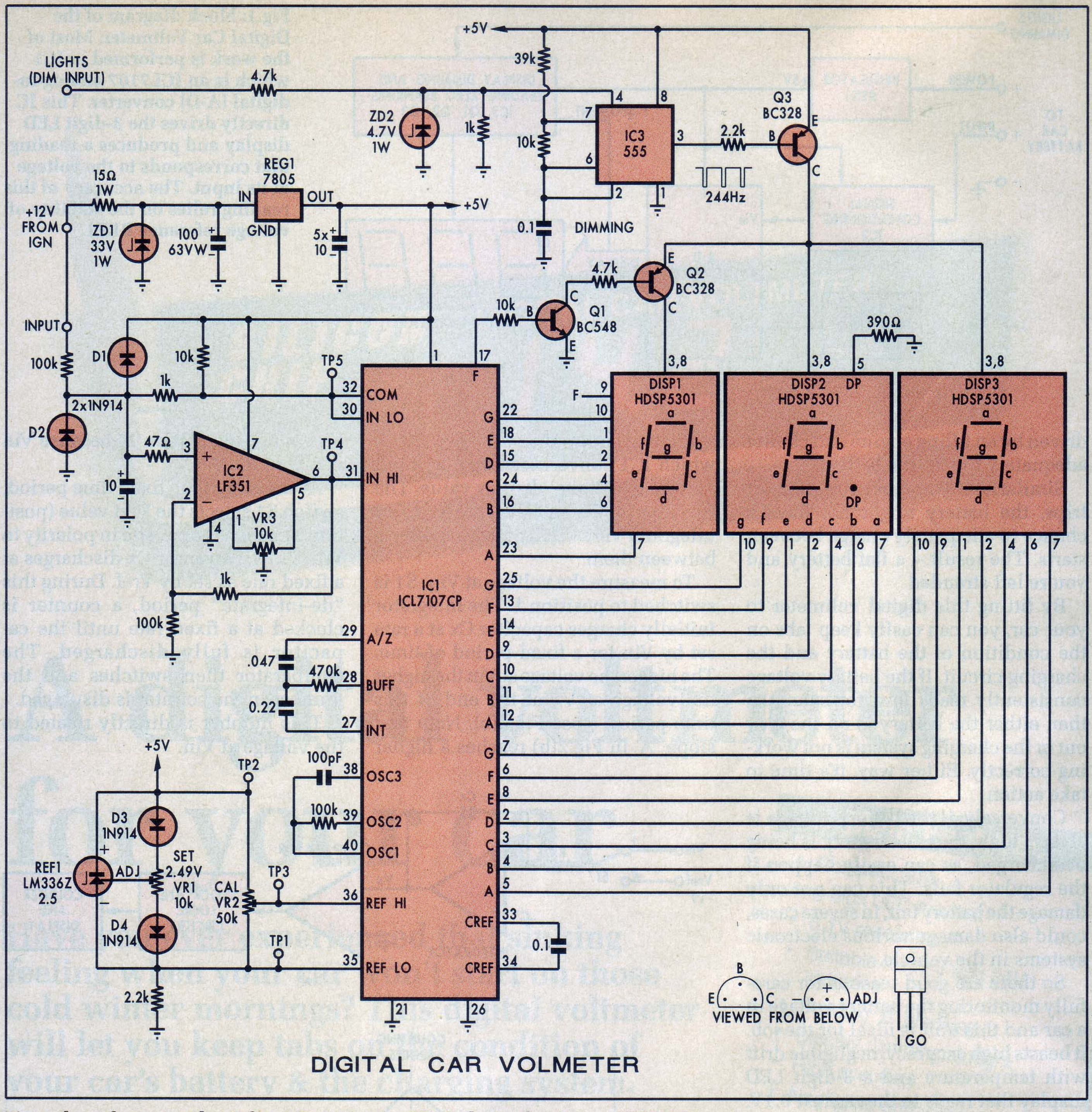


Fig.3: the reference voltage for A-D converter IC1 is derived using an LM336Z-2.5 (REF1). It's output is divided and applied to the REF HI and REF LO inputs. IC2 and its associated parts condition the signal input, while IC3 provides the display dimming feature.

This method of A-D conversion is often used in digital voltmeters. It has the advantage that the accuracy is only dependent on the accuracy of the reference voltage. Although the technique uses a clock to set the fixed time during the integrate period and the count rate during the de-integrate phase, the stability of the clock is not overly important as far as conversion accuracy is concerned. That's because the resulting digital value is not dependent on the clock rate.

To understand why, let's consider what happens if the clock is slower than normal. In that case, the Vx value will be higher than expected after the integrate stage and it will take longer to discharge Cx to 0V (ie, the de-integrate stage will take longer). However, that's compensated for because the counter is clocked at a slower rate over this longer time period.

As a result, the same value will be recorded, regardless of clock rate. Of course, if the clock rate is far too slow, the integrator may saturate because its output reaches the limit of the supply voltage.

Conversely, if the clock is too fast, Vx will be lower but the counter will be clocked at a faster rate during the discharge period. Thus, any drift in the clock rate over time is cancelled in the conversion process, provided that the clock rate does not drift between conversions.

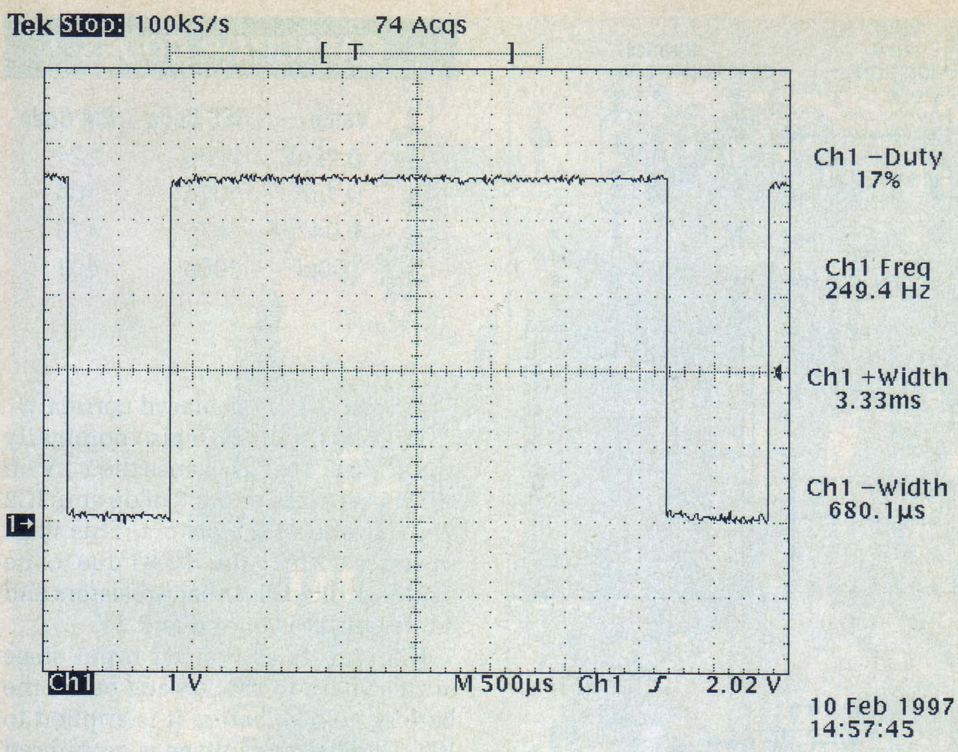


Fig.4: this is the waveform at the output of the 555 timer (IC3) when the car's lights are on. Because the waveform is low for only 17% of the time, Q3 is only on for this time and so the displays are dimmed.

Returning to Fig.1, the car battery voltage is applied to regulator REG1 and to a signal conditioning circuit based on IC2. The regulator provides a 5V supply rail, while the signal conditioning circuit converts the input signal to a voltage range suitable for feeding to IC1.

The display is controlled using dimming and leading "0" blanking circuitry. Leading "0" blanking is a cosmetic feature that blanks the first digit when the reading is below 10V.

The leading zero blanking circuit works by detecting when the "f" segment in the most significant display is driven and then switching the whole display digit off. The "f" segment is only driven if 0, 4, 5, 6, 8 and 9 are to be displayed. Since we are only interested in displaying values well below 40.0, blanking the leading digit for values above "3" is of no consequence.

The display is dimmed when the dimming input is pulled high. This activates an oscillator which turns the displays on for only 17% of the time, thereby effectively reducing the average display brightness. The switching speed of the oscillator is set high enough so that the display doesn't flicker.

Circuit details

Refer now to Fig.3 for the circuit details. At the heart of the design is an Intersil ICL7107CPL 3½-Digit Single Chip A-D Converter (IC1). It directly drives the three 7-segment LED displays and only requires a few extra components to make it work. The clock components are at pins 38, 39 & 40, while the RC network for the integrator is at pins 27 & 28.

To improve accuracy and remove any offsets in the internal op amps, an auto zero capacitor has been included at pin 29. A reference capacitor at pins 33 & 34 is used to store the reference voltage during the de-integrate stage of the dual-slope D-A conversion.

The reference voltage is derived using an LM336Z-2.5 (REF1). This device is connected between the +5V rail and the REFLO input of IC1. The current through REF1 is set to about 1mA using a 2.2kΩ resistor, while diodes D3 and D4 are used to compensate the reference for temperature variations. Trimpot VR1 is adjusted to set the reference to 2.490V, at which point it has a minimum temperature coefficient.

VR2 divides the 2.490V from REF1 to provide a stable 1V reference voltage between REFLO and REFHI. This sets the full scale input for IC1 to 1.999V. However, because we are only using three digits, the display can only

PARTS LIST

- 1 PC board, code 04304971, 117 x 102mm
- 1 PC board, code 04304972, 88 x 30mm
- 1 front panel label, 132 x 28mm
- 1 ABS case, 140 x 110 x 35mm
- 1 red transparent Perspex sheet, 46 x 22 x 2-3mm
- 1 small TO220 heatsink, 30 x 25 x 13mm
- 1 3mm x 6mm long screw plus nut
- 4 9mm untapped standoffs
- 4 3mm x 15mm screws
- 9 PC stakes
- 1 60mm length of 0.8mm tinned copper wire
- 3 HDSP-5301 12.7mm high common anode LED displays
- 2 10kΩ horizontal trimpots (VR1, VR3)
- 1 50kΩ horizontal trimpot (VR2)

Semiconductors

- 1 ICL7107CPL 3½ digit A-D converter (IC1)
- 1 LF351, TL071 single op amp (IC2)
- 1 555 timer (IC3)
- 1 7805 5V regulator (REG1)
- 1 BC548 NPN transistor (Q1)
- 2 BC328 NPN transistors (Q2,Q3)
- 1 LM334Z-2.5 reference (REF1)
- 1 1N4752 33V 1W zener diode (ZD1)
- 1 1N4732 4.7V 1W zener diode (ZD2)
- 4 1N914, 1N4148 diodes (D1-D4)

Capacitors

- 1 100µF 63VW PC electrolytic
- 6 10µF 16VW PC electrolytic
- 1 0.22µF MKT polyester
- 2 0.1µF MKT polyester
- 1 0.047µF MKT polyester
- 1 100pF MKT polyester or ceramic

Resistors (0.25W, 1%)

1 470kΩ	2 2.2kΩ
3 100kΩ	3 1kΩ
1 39kΩ	1 390Ω
3 10kΩ	1 47Ω
2 4.7kΩ	1 150Ω 1W 5%

Miscellaneous

Automotive wire, automotive connectors, solder, etc.

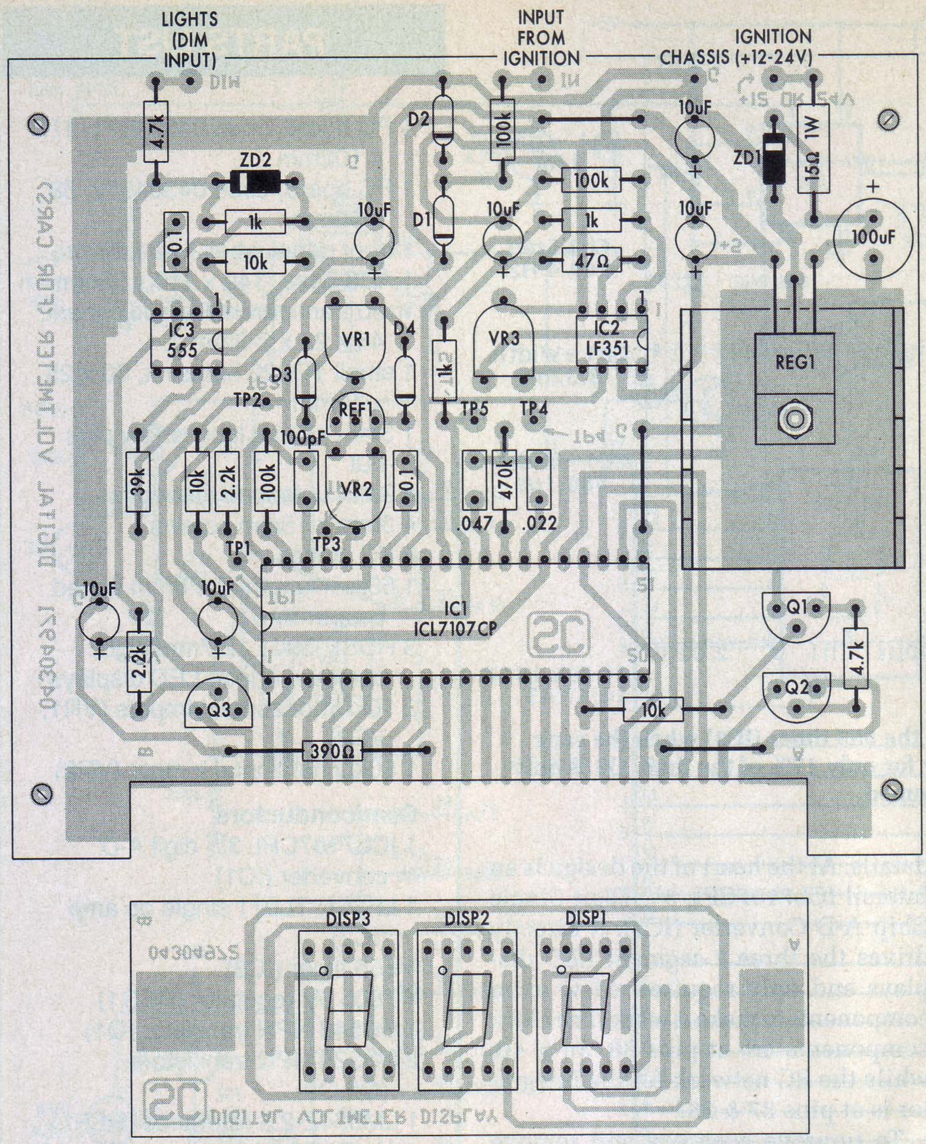


Fig.5: the 7-segment displays must be installed with their decimal points at top left, as shown here. Make sure that all polarised parts are correctly oriented.

CAPACITOR CODES

	Value	IEC Code	EIA Code
❑	0.22µF	220n	224
❑	0.1µF	100n	104
❑	0.047µF	47n	473
❑	100pF	100p	101

show up to 999mV (ignoring the leading zero blanking).

The COM pin (pin 32) sits at a nominal 2.8V below the +5V supply rail; ie, at 2.2V. This means that INLO also sits at 2.2V, since it is tied to COM. The 10kΩ resistor between the COM pin and the +5V rail ensures that the COM pin supply is biased correctly.

With no input, INHI also nominally sits at 2.2V. That's because the 2.2V on COM is applied to pin 3 of op amp IC2 via 1kΩ and 47Ω resistors. This stage operates with a gain of 1.01 due to the 1kΩ and 100kΩ feedback resistors and so its output is biased to 2.2V.

IC2 and its associated input stage are also used to process and buffer the battery voltage before it is applied to IC1. The battery voltage is monitored via the ignition switch and is divided by 100 via a 100kΩ input resistor and the 1kΩ resistor connected to COM. This divided voltage is effectively added to the 2.2V bias voltage and then fed to IC2.

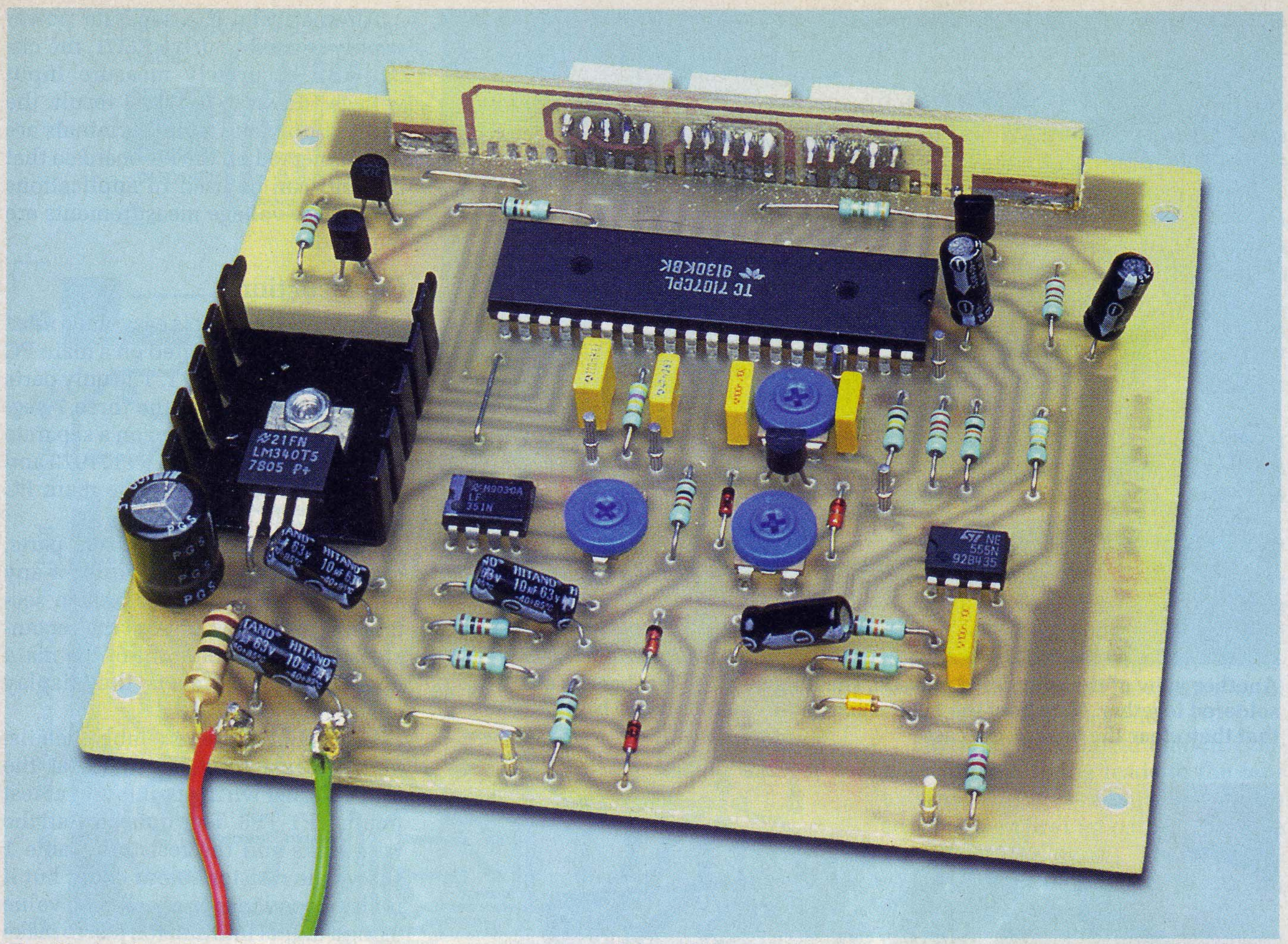
Let's say, for example, that 10V is applied to the input. This is divided to 100 and added to the 2.2V bias to give 2.3V on pin 3 of IC2. IC2 then buffers this voltage and applies it to the INHI input of IC2.

As a result, the difference between the INHI and INLO inputs is 2.3V - 2.2V = 100mV. This is then displayed as 10.0 (ie, 10.0V) on the LED readouts.

Diodes D1 & D2 are included to suppress any voltage spikes which could otherwise go beyond the supply rails and damage IC2. The associated 10µF capacitor also damps any

TABLE 1: RESISTOR COLOUR CODES

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	470kΩ	yellow violet yellow brown	yellow violet black orange brown
❑	3	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	39kΩ	orange white orange brown	orange white black red brown
❑	3	10kΩ	brown black orange brown	brown black black red brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	2	2.2kΩ	red red red brown	red red black brown brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	1	390Ω	orange white brown brown	orange white black black brown
❑	1	47Ω	yellow violet black brown	yellow violet black gold brown
❑	1	150Ω	brown green black	not applicable



The display board is soldered at right angles to the main PC board, as shown here (see text). Note the U-shaped heatsink fitted to REG1. This should be securely fastened to the board so that it can't short against other parts.

voltage spikes. Trimpot VR3 is used to adjust the offset of IC2's output so that the display reads 0.0 when the input is connected to ground.

The LED displays are common anode types and are all controlled by Q3. In addition, the leading digit (DISP1) is controlled by Q1 and Q2. Normally, the "f" segment output from IC1 is high and so Q1 & Q2 are on and DISP1 is turned on via Q3. However, if the "f" segment output for the DISP1 digit goes low (eg, if a zero is to be displayed), Q1 turns off. This then turns off Q2 and so DISP1 also turns off to provide the leading zero blanking feature.

Display dimming

When the car's lights are off, pin 4 of 555 timer IC3 is pulled low and so its pin 3 output is also low. This means that Q3 is on and so the displays run with a 100% duty cycle for full brilliance.

When the lights are turned on, pin 4 of IC3 is pulled to 4.7V (as set by ZD2) and so IC3 begins to oscillate. Its operating frequency is set to about 244Hz while the duty cycle is about 83%, as set by the RC timing components on pins 2, 6 & 7.

This means that pin 3 is low for only about 17% of the time. And since Q3 is only on when pin 3 is low, it follows that the displays only operate with a 17% duty cycle. This reduces the display brightness, so that they don't become intrusive at night.

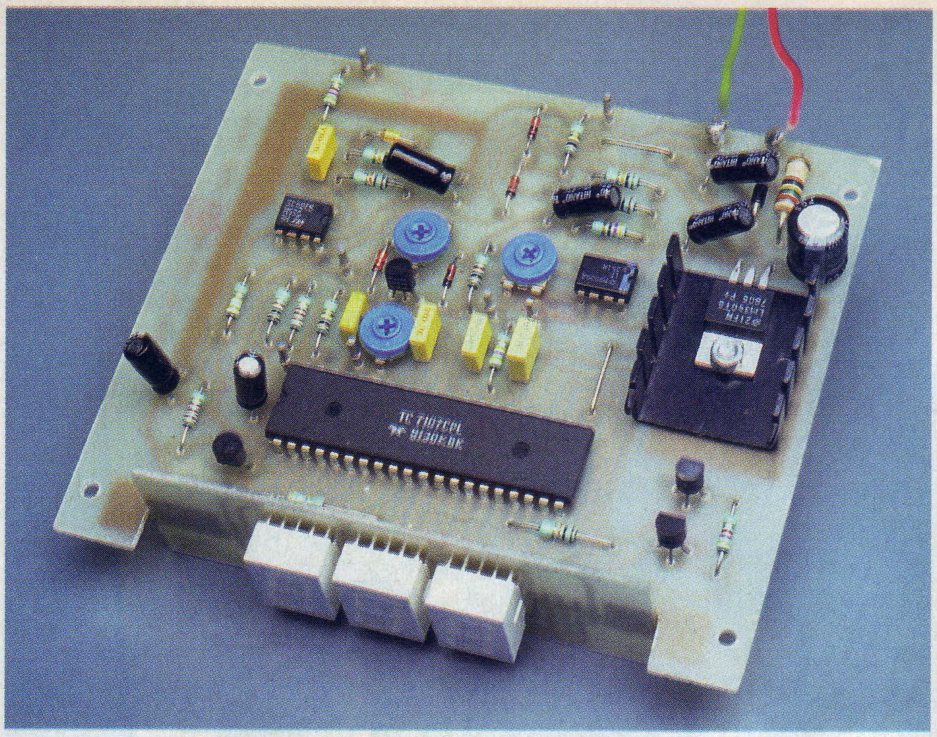
Power supply

Power for the circuit is derived from the car's battery via the ignition switch. The 15Ω resistor and zener diode ZD1 provide transient suppression, while the 100µF capacitor provides filtering. The filtered voltage is then fed to a 3-terminal regulator which produces a 5V supply for IC1, IC2 and IC3.

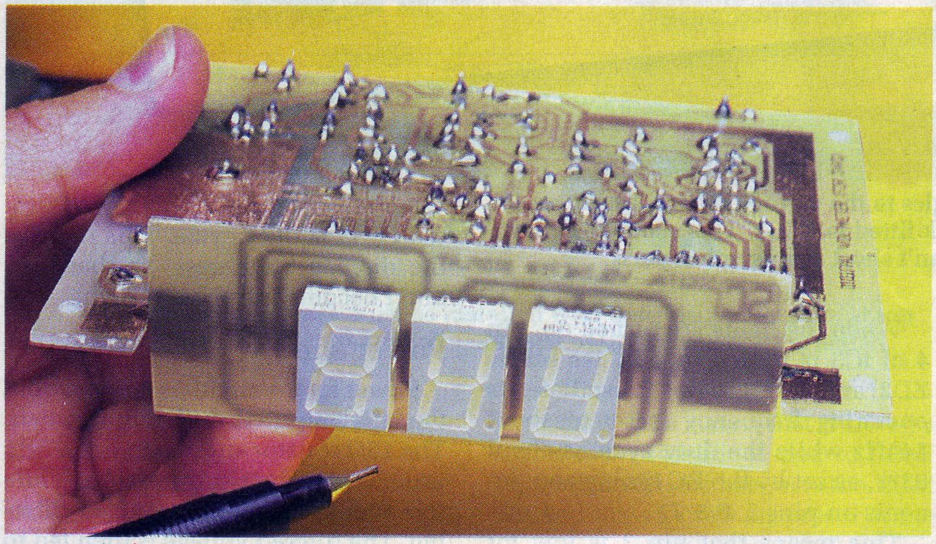
Normally, the supply voltage to the

SPECIFICATIONS

- Voltage range 8-33V (0-39.9V when separately powered)
- Resolution 0.1V (100mV)
- Accuracy within 0.1V
- Temperature drift less than 0.5% from 0-60°C
- Quiescent current 130mA @15V, 150mA @ 30V (full brightness)
- Input impedance 100kΩ
- Input current -27µA @ 0V, 0µA at 2.2V, 122µA @ 15V



Another view of the completed module, showing how the two boards are soldered together. Note how the 10μF electrolytic capacitors are bent over so that they clear the base of the case.



The completed module is mounted upside down in the case, so that the display decimal points are at bottom right. The board is secured on 9mm spacers using 12mm-long screws which go into integral standoffs on the base of the case.

circuit is connected to the input so that the battery voltage can be measured. However, if the input voltage to the regulator drops below about 8V, the circuit will give misleading results because of low voltage to the ICs. This is of no concern for a car battery voltmeter.

Alternatively, if a separate power supply is used to drive REG1, the circuit can accurately measure input voltages down to 0V. As a result, the +12V supply and input terminals are not connected on the PC board so that the unit can be used in applications where low voltage measurements are required.

Construction

Building this unit is easy since most of the parts are mounted on a main PC board coded 04304971. The only parts not on this board are the three 7-segment displays. These go on a separate display PC board coded 04304972 and this is then soldered to the main PC board at right angles.

Before mounting any of the parts, carefully check the PC boards for any shorts between tracks or broken sections. If necessary, cut out the rectangular section at the front of the main board, where it meets the display board.

Fig.5 shows the assembly details. Start by installing PC stakes at the four external wiring points and at test points TP1-TP5. This done, install the wire links and the resistors. Table 1 shows the resistor colour codes but it is also a good idea to check each value using a digital multimeter, just to make sure.

Next, install the ICs, followed by the capacitors, diodes, zener diodes and the transistors. Make sure that all these parts are correctly oriented and that the correct type number is used at each location. In particular, don't confuse transistors Q1 and Q2.

The regulator (REG1) is mounted horizontally on the PC board with its leads bent at rightangles. It is then secured to both the board and a U-shaped heatsink using a screw, nut and lockwasher. A second heatsink should also be fitted to the copper side of the board if the unit is to be used with a 24V battery. Make sure that this second heatsink doesn't short out any of the tracks.

The display board can now be

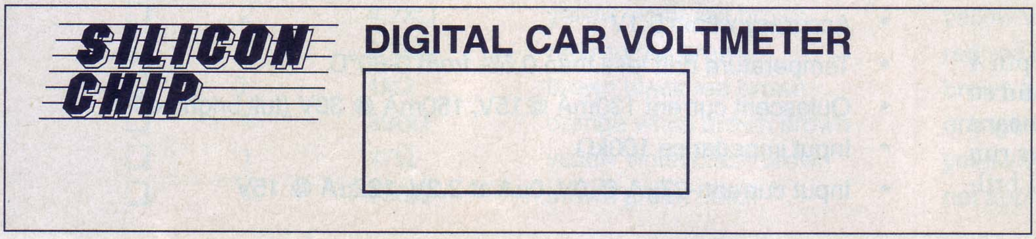


Fig.6: this full-size front panel artwork can be used as a template for cutting out the display window.

functioning correctly and you can proceed with the calibration.

Calibration

The calibration procedure is quite straightforward – just follow this step-by-step guide:

(1) Connect a multimeter between TP1 and TP2 and adjust VR1 for a reading of 2.490V (this will give the minimum temperature drift for REF1).

(2) Connect a multimeter between TP1 and TP3 and adjust VR2 for a 1V reading. This calibrates the full scale reading for the A-D converter.

(3) Connect the INPUT terminal on the PC board to GND and adjust VR3 for a 0.0V reading. This sets the offset output of IC2.

(4) Connect the INPUT and +12V terminals together and connect the multimeter between these terminals and GND. Check that the display shows the same reading as the multimeter. If not, adjust VR2 slightly until the readings are the same.

That completes the calibration. Connect suitable flying leads to the four external wiring terminals and drill a small hole in the rear panel to provide an exit for these leads. The board assembly can now be finally secured to the base of the case.

Finally, complete the construction by fitting the front panel. One approach is to substitute a piece of red Perspex for the whole of the front panel, with the area outside the display panel suitably masked (eg, with a stick-on label). Alternatively, you can cut a display window out of the existing panel and fit this with a red Perspex window for the displays.

Installation

The Digital Car Voltmeter can be installed on the dashboard of the vehicle. It is wired to the ignition, lights and ground connections on the fused side of the fusebox. Use automotive connectors for all wiring.

The ground connection can be made to the chassis using an eyelet crimp-lug which is secured to the metal using a self-tapping screw. The separate INPUT connection to the voltmeter can be made at the fusebox, at a point which is switched via the ignition switch but which has a low current drain. This will ensure that the voltmeter is not measuring a low voltage due to drops across the vehicle wiring. SC

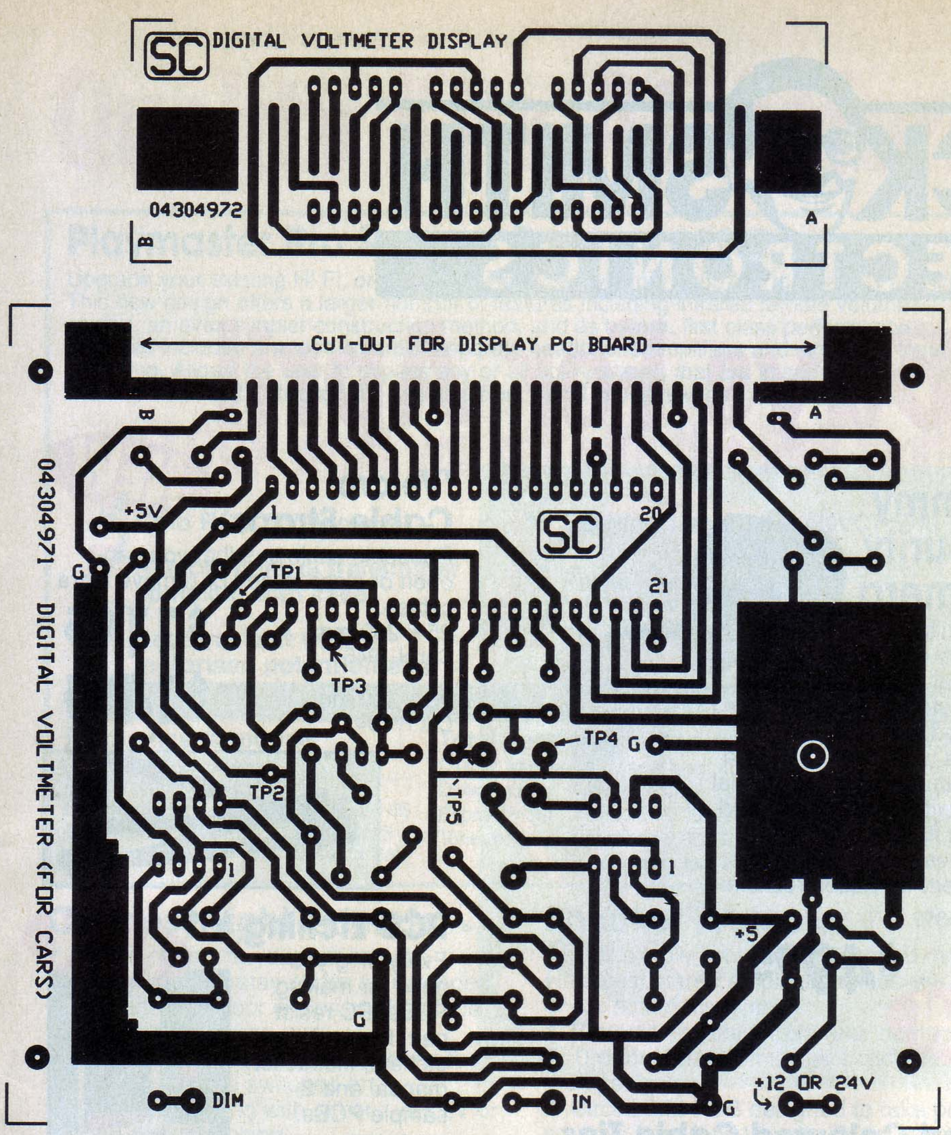


Fig.7: check your etched PC boards against these full-size artworks before installing any of the parts.

quickly assembled by installing the three LED displays. These must all be oriented with their decimal points at top left, as shown on Fig.5.

Final assembly

The unit is housed in a small ABS case measuring 140 x 110 x 35mm. This is fitted with a self-adhesive front panel label, while a red Perspex window covers the display area.

The main job in the final assembly is to solder the two PC boards together at right angles. To do this, first mount the main PC board upside down on the base of the case and secure it on 9mm spacers using 3mm x 12mm-long screws. This done, the display board is butted against the main board and the two large end pads soldered. Make sure that the two boards are at rightangles and that the bottom edge of the display board rests against the case before making these connections.

The PC board assembly should now be removed from the case and the remaining edge pads soldered together. Apply a generous fillet of solder to the two large end pad connections to ensure sufficient mechanical strength.

Now for the smoke test but first go back over your work and carefully check for any errors. In particular, check that all parts are correctly oriented, that the correct part has been used at each location and that there are no missed solder joints.

If everything is correct, apply power and check that the display lights up (note: only the last two digits should light). If it doesn't, check transistor Q3. Now check for +5V at the output of the regulator (REG1), at pin 1 of IC1, at pin 7 of IC2 and at pin 8 of IC3.

Next, check that the display dims when +12V is applied to the LIGHTS input. If it does, the unit is probably

DICK SMITH ELECTRONICS

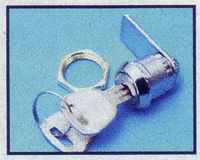
Great Buys For April

Key Lock Tumblers

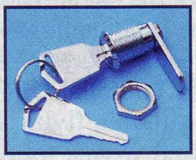
NEW

Add the element security to all your projects.

32 mm Cam.
Cat L-5297
$4.95

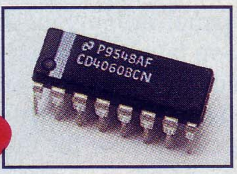


25 mm Cam.
Cat L-5298
$4.95



4060 14 Stage Binary Counter

An addition to our wide range of 4000 family devices, this is a 14-stage ripple-carry binary counter/divider and oscillator, including 10 buffered outputs plus an overriding asynchronous master reset input.
Cat Z-5660
$2.65



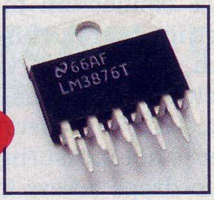
NEW

Audio Power Amp LM3876T 50W RMS

56W continuous average output power into 8 Ohms

- 100W instantaneous peak output power
- 11-lead staggered pin T0-220 package
- 24V to 84V operating supply voltage
- Used in K-5606 50W amp module kit

Cat Z-6119
$11.95



NEW

Dummy Security Camera

This imitation security camera is ideal for small shops as a theft deterrent. Easily installed with a couple of screws in to a wall It uses a real camera housing, coaxial cable with 'F' connector and in-built flashing red LED (requires power supply not included) for added realism.
Cat L-5850
$49.95

NEW

Mixed Coloured Cable Ties

Small 96mm Pack 100
(10 colours x 10 pcs)
Cat H-1959
$9.95

Large 190mm Pack 100
(10 colours x 10 pcs)
Cat H-1961
$14.95

Magellan GPS-3000XL

NEW

The Magellan GPS-3000XL is a compact hand held GPS receiver with a large LCD screen, rugged plastic case filled with dry nitrogen gas to exclude moisture, and an internal antenna for ease of use. The XL version is an enhanced model of the previous GPS-3000, and is supplied with a carry case, swivel mounting bracket, and DC power module. Can also be connected to a PC via an optional interface.
Cat D-3915
$650

MAGELLAN GPS SYSTEMS

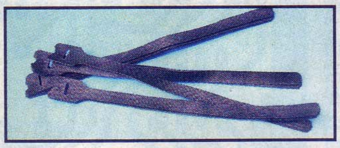
'Velcro' Cable Straps

NEW

Reuseble cable ties that you can open or close to add or remove extra cables.

25 x 200 mm
Cat H-1946
$11.95

25 x 300 mm
Cat H-1947
$14.95



PCB Etching Kit

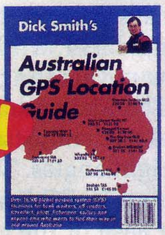
NEW

Everything you need for making PCBs. PC resist pen, Ferric Chloride etchant, instruction manual and 2 sample PCBs.
Cat N-5651
$26.95

Australian GPS Location Guide

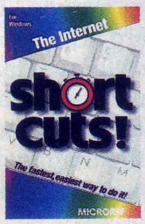
The ultimate companion to your hand held GPS. Handy guide to 16,500 global position system locations. Specifically compiled for Australia. Suited to anyone using a GPS who is trying to find their way around the Australian continent - no GPS owner should be without one. 160 pages.
Cat B-9650
$14.50

NEW



The Internet Short Cut Book

Navigate your way around the web faster with this pocket book of net short cuts.
Cat B-8125
$4.95



Quality Kits At Affordable Prices

Playmaster Pro Series 4 Preamp

Upgrade your existing Hi-Fi, or it's great when used with our K-5570 Pro Series 3 amplifier. This new design offers a larger number of features including infrared remote volume control, an even simpler construction method, and as before, first class performance. Features included are tone controls, separate headphone amplifiers and extensive input switching. Allows the user to bypass any or all active stages that are in series with the audio path, through the use of a front panel 'mode' switch. Cat K-5555

NEW

EA Dec '96/Jan '97

$229

LOOK what you get with this Dick Smith Electronics Kit

- Gold RCA connectors
- Remote control transmitter complete with case
- Receiver unit with motorised potentiometer
- Specified transformer (30VCT 5VA)
- Phono preamp section
- Pre-punched chassis
- Punched & screened front panel
- Components & hardware
- MKT caps & metal film resistors

Performance Data

Frequency response
(line inputs, typical load)

Direct mode:	Unrestricted
Bypass mode:	15Hz to 30kHz + 0/-1dB
Tone mode:	20Hz to 20kHz +/-1dB with controls set to 'flat'

Total harmonic distortion
(20kHz bandwidth, typical load, at 1VRMS output)

Direct mode:	Unmeasurable
Bypass mode:	Less than 0.002%
Tone mode:	Less than 0.002% Input and output levels

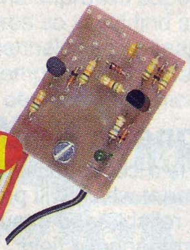
Input and output levels
(Volume control at maximum, line inputs)

Direct mode:	1V in for 1V out	(max output: unrestricted)
Bypass mode:	240mV in for 1V out	(max output: 7V RMS)
Tone mode:	240mV in for 1V out	(max output: 7V RMS)

Courtesy Light Extender

- Fit this project to your car and the courtesy light will stay on for an extended period after the door is closed, then fade out gradually.
- Cancels the delay extension when the car headlights are switched on.
- Suits lamp wiring with either +ve 12V or ground door switching.
- Extends light-on time by about 10 seconds.
- 3 wire connection to car.
- Installation can be made without cutting wires.
- Kit is supplied in shortform (PCB and components only).

Cat K-4100



NEW

EA Apr '97 **$9.90**

Speaker Protector

- This simple circuit is designed to mate with most stereo amplifiers, music systems or car sound systems.
- Protects speakers from amp damage.
- Turn-on delay eliminates switch-on thumps.
- Circuit and PCB designed to take power sources from 9 or 12 volts DC or from +30v to +70 volts DC (ie using the internal power source of an existing amplifier).
- Kit supplied in shortform with all components, PCB and Hi-power relay.

Cat K-5414

$19.50

NEW

SILICON CHIP Apr '97

Kit Train Controller

- This easy to build train controller will give full, realistic control of your model trains.
- Full reverse to full forward speed.
- Inertia and brake switch automatic.
- Includes overload protection.
- Kit is supplied in shortform and includes only components, PCB and heatsink.
- Transformer required - M 2165 (9V-0-9V)

Cat K-3029

$26.95

NEW

Case & accessories shown not supplied.

SILICON CHIP Apr '97

Analogue Multimeter

Build this very useful piece of test equipment and at the same time learn all about analogue multimeters. Has 19 ranges with 20K/V and includes features such as transistor check, mirrored scale and continuity. Kit is supplied complete with all components, hardware, PCB, comprehensive instructions, deluxe multimeter case and test leads which plug into recessed sockets for added safety. Instructions and parts will also be supplied to construct the transistor test adaptor lead.

Cat K-1050

$29.60

SILICON CHIP Feb '97

PC Driven Function Generator

This kit will save you hundreds of dollars over commercially available models. And it has greater features than most, with the ability to create virtually all waveforms from 0.25 Hz to beyond 100kHz. Using a novel application of direct digital synthesis this waveform generator is perfect for anyone who uses waveform for testing. Supplied complete with all components, hardware, PCB, case, transfromer, pre-punched screened front panel and required software on a 3.5" disk.

Cat K 7348

$99

EA Mar '97

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

This Month's Specials!

LCR Multimeter

3.5 digit (2000 count) display. Continuity and diode test. Transistor and capacitance. Frequency and duty cycle. Inductive and logic test. Input warning beeper. Auto power-off. Includes test leads and holster.

Ranges:

DC volts:	200mV-1,000V
AC volts:	200mV-750V
AC/DC current:	20mV-20A
Resistance:	200ohms-2,000Mohms
Capacitance:	2nF-200uF
Frequency:	2KHz-20KHz
Inductance:	20mH-20H

Cat Q 1559

SAVE $50

$129

Digital Multimeter

This rugged 3.75-Digit (4000 count) digital multimeter is great for both field and workshop use, especially at this unbelievable price. It is shock resistant and comes with rubber holster for added protection. Features include continuity, diode and logic testing, peak hold and auto power off. Thermocouple probe included.

Ranges:

DC Volts:	400mV, 4V, 40V, 400V, 1,000V
AC Volts:	400mV, 4V, 40V, 400V, 750V
DC Current:	400uA, 4mA, 40mA, 400mA, 20A
AC Current:	400uA, 40mA, 400mA, 20A
Resistance:	400, 4K, 40K, 400K, 4M, 40M ohms
Frequency:	4KHz, 40KHz, 400KHz, 4,000KHz
Temperature:	Thermocouple supplied: -40 to 260 degrees C
Unit's range:	-50 to 1,300 degrees C

Cat Q 1542

SAVE $50

$129

Prototype Fibreglass PCBs

A. 103 x 60mm double-sided printed circuit board. **$4.95**
Cat H-5611

B. 95 x 85mm single-sided printed circuit board. **$4.95**
Cat H-5613

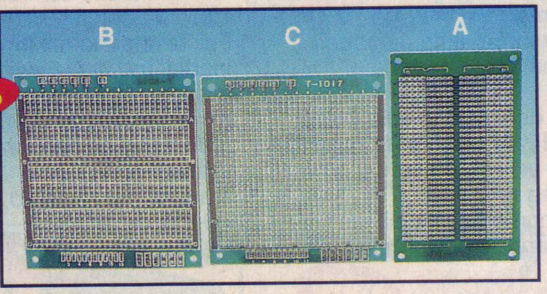
SAVE $3ea

Prototype Matrix PCB

C. 95 x 85mm single-sided printed circuit board.
Cat H-5615

$4.95

SAVE $3



Antistatic Bags

Ideal for storing those delicate components.

3" x 5"
Cat H 6020
$1.50 Pkt of 5

5" x 8"
Cat H 6025
$1.95 Pkt of 5

Digital Lux Meter

Perfect for photographers, video makers and photo labs. Quickly and accurately measures light up to 50,000 LUX over three ranges. Features auto zero, low battery indicator and comes complete with carry case. Requires 1 x 9 volt battery which gives 150-200 hours continuous use.

Cat Q 1400

$99

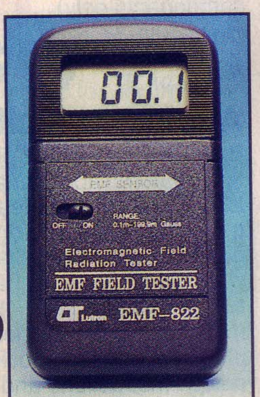
SAVE $40

Electromagnetic Field Tester

This EMF Tester is a cost effective, hand-held instrument which will provide you with a quick, reliable and easy way to measure electromagnetic field radiation levels generated by power lines and cables, computer monitors, TV sets, video equipment and many similar devices. 3.5 digit (LCD) display.

Range :	0.1m to 199.9m gauss.
Band width:	30Hz to 300Hz.

Cat Q 1225



$129

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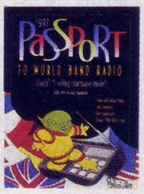

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BOOKSHELF

Handy reference on microcomputer interfacing & applications

Microcomputer Interfacing and Applications, M. A. Mustafa, published January 1995 by Newnes. Soft covers, 233 x 155mm, 456 pages. ISBN 0 7506 1752 7. Price $69.00.

This is the second edition of this book which, in its 17 chapters, reasonably fully covers all aspects of the operation and interfacing of micros to the outside world.

The first chapter is pitched at the beginner who is assumed to have little or no knowledge of the subject. It covers processors, storage devices, input/output (I/O) devices, microprocessor operation, task execution and interrupts.

Chapter two explains why external devices may need to be connected to a microcomputer, the methods used to communicate with these devices and the concept of input and output ports.

The next chapter expands on this by discussing the need for flexibility in and optimisation of any add-ons that you may use. The boards which are described are mostly for the IBM style computer and its clones, mainly because of the diverse range of off-the-shelf boards which have become available for this type of computer.

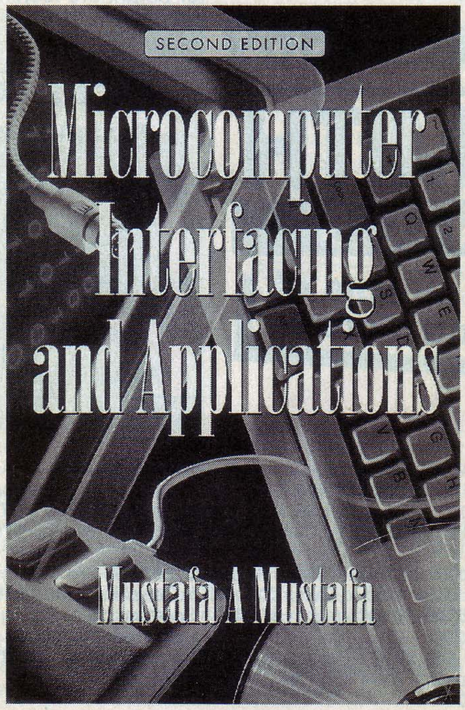
Mustafa then goes on to compare the pros and cons of interrupt versus program controlled output. The chapter concludes with a few examples of the decoding of external address spaces.

Chapter four, entitled Using Digital Input and Output Ports, begins by showing the methods used to detect external switch closures and includes a discussion on switch debounce using both hardware and software. It continues by explaining how comparators can be used to indicate out of tolerance voltages.

Hardware logic gates are covered next, followed by an explanation of how the various gates can be implemented in software if there are sufficient processor input lines available. Most of the balance of the chapter is taken up with the solutions to various problems, using both hardware and software approaches.

The last 10 pages of this chapter discuss AC, inductive loads and power factor.

Chapters five to eight cover, in great detail, Multiplexers, Sample and Hold circuits, and Digital to Analog (D/A) and Analog to Digital (A/D) converters. This information will be familiar to the experienced hobbyist or engineer but should prove enlightening to the novice.



Chapter six explains how D/A converters can be interfaced to a microprocessor and chapter seven does the same for A/D converters. Chapter eight details the application of several commercial devices to the solutions of some hypothetical problems.

The next chapter covers external counters and timers, although most modern micros now seem to include these on the chip. Still it is often easier to implement counting or timing functions in hardware using an interrupt, than in software, as these functions can occupy a large percentage of the processor's time.

Applications using several timers, including that old favourite the 555, are shown. Methods of measuring frequency, time intervals and phase shifts are examined, almost always using external hardware to process the input signals.

Chapter 10 diverges from micros to discuss switching devices, although the ultimate end is to control these via a computer. Diodes, zeners, transistors, FETs, MOSFETs, IGBTs, SCRs, thyristors, Triacs and relays are all included in this summary.

The important subject of isolating control circuits from the mains supply is adequately covered.

The next chapter, titled Optical Devices, is a continuation of the previous one. It covers light sensing devices such as photodiodes, phototransistors, light dependent resistors and light emitting devices such as

opto-couplers, light emitting diodes (LEDs) and 7-segment LED displays. Methods of interfacing these different devices to micros are shown and an explanation is given of the way LED displays are multiplexed.

The chapter concludes with nearly nine pages which cover optical encoders. The incremental encoder is widely used but suffers from the problem that it can only count pulses but cannot give any absolute position. To increase their usefulness, modifications have been made such as an extra output providing one pulse per revolution at a predetermined position.

Absolute encoders overcome the previous problems by representing each position by a unique code but this obviously will require more input data lines to a processor.

Chapter 12 explains how to generate waveforms, again by utilising either software or hardware under computer control. Mustafa begins this chapter by discussing the types of waveforms that are usually generated by hardware, then compares the pros and cons of real time calculations versus look-up tables. He continues with examples of the generation of different waveforms using both digital and analog interfaces for frequency selection. The chapter also shows how DC offsets can be generated and added to the output waveform.

The 13th chapter introduces us to microcomputer controlled robotic mechanisms. Both analog and digital, open and closed loop controls are covered. While the chapter is quite comprehensive, the robot designers will know it all and the hobbyist is unlikely to begin designing robots after reading it.

Temperature measurement and control is the heading for chapter 14. The various types of sensors including thermistors, thermocouples, RTDs (resistance temperature detectors) and semiconductors are explained.

The methods used to control the temperature once it has been sensed are then described. These are on/off, pulse width, phase angle and zero crossing switching. Some examples of these methods are then given.

A chapter on motor control is next. Many industrial process control systems will, as part of their task, control the speed of a motor. As we know there are two types of motors, DC and AC and they, unfortunately, require different methods of control.

The author describes the various types of DC motor speed control using the computer in a closed loop system, then other methods which use some external hardware but don't take as much computer processing time.

The speed of an AC motor can be varied by altering either the applied voltage or the applied frequency. While the latter is harder to implement, it is the more efficient method, as the output torque is higher. Various methods using voltage, frequency and pulse width to vary the motor speed are then described.

The penultimate chapter, headed Miscellaneous Applications, covers such things as interfacing a keypad to a micro, interrupt control, DMA (direct memory access) and handshaking. It continues by discussing rudimentary process control test procedures, the provision of additional supplies to power the external add-ons and battery backup of these add-ons.

The final chapter talks about the possible limitations of an existing computer system and the upgrade paths available. It also describes the limited storage of RAM and the probable need to transfer RAM data to a hard disc. Brief mention is then made of operating systems, programming languages and emulators.

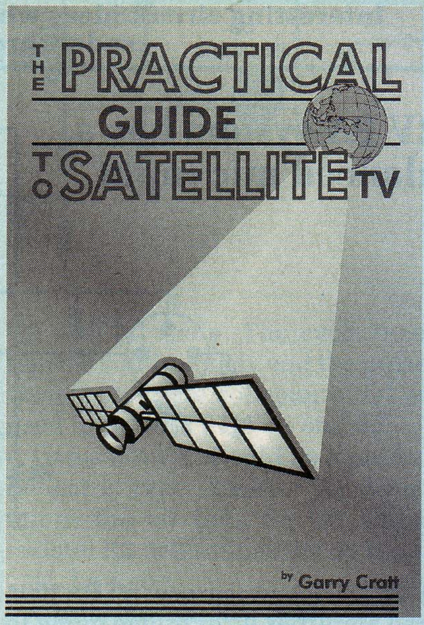
An emulator is a collection of hardware which allows a software program (eg, for a microcontroller) to be loaded into it and executed. The program steps can be traced and intermediate values checked to confirm the correct operation of the program before it is "burned" into the final device. If "bugs" are found, the program can be altered then run again to verify its correct operation.

To sum up, this book is a good reference for the hobbyist or student who wants to have a better understanding of the topics covered. It contains lots of worked examples to illustrate each chapter and is an ideal starting point.

Our review copy came from Reed International Books Australia Pty Ltd. Phone (03) 9245 7168. (R.F.W.) **SC**

Practical Guide to Satellite TV

The Practical Guide to Satellite TV, by Garry Cratt. Published February 1997. ISBN 0 646 30682 0. 296 x 210mm, soft covers, 116 pages. R.R.P. $39.00.



Published in February this year, this easy-to-read book has been compiled by one of the most experienced satellite TV installers in Australia, Garry Cratt. It is written in an informal style and is copiously illustrated.

Topics covered include a history of satellite development, principles of satellite operation, earth station components, encryption systems, video standards, video compression (MPEG, etc), system installation and wiring.

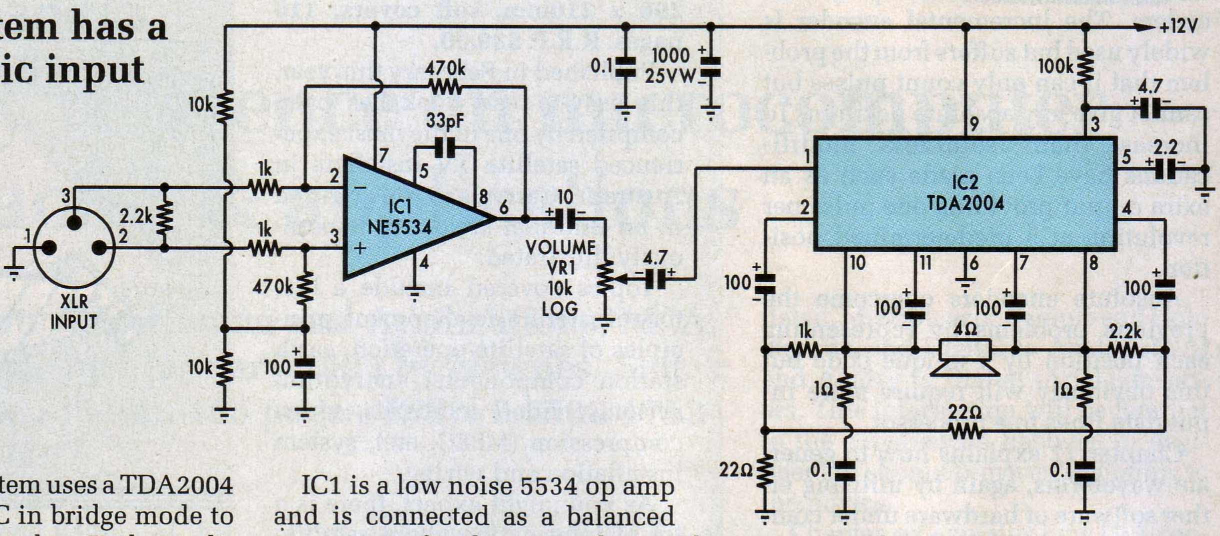
As you might expect, there is a lot of information about satellite receiver hardware such as dishes, feedhorns, polarisers, LNBs (low noise block converter) and so on. There is a large glossary and 46 pages of satellite orbital data, transponder loading and footprints.

In summary, this book is down to earth and up to date. It is available at $39.00 plus $5 postage from Av-Comm Pty Ltd, PO Box 225, Balgowlah, NSW 2093. Phone (02) 9949 7417; fax (02) 9949 7095.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

12V PA system has a balanced mic input



This 12V PA system uses a TDA2004 stereo amplifier IC in bridge mode to drive a 4Ω loudspeaker. Both amplifier outputs at pins 8 & 10 have Zobel networks (1Ω & 0.1μF) to ensure stability, while the 100μF capacitors provide bootstrapping to the driver stages. The power output is about 20W.

IC1 is a low noise 5534 op amp and is connected as a balanced input stage for the microphone. The input impedance is set by the two 1kΩ resistors while the overall gain is set by the ratio of the two 470kΩ resistors to the two 1kΩ resistors. Frequency compensation is provided by a 33pF capacitor between pins 5 & 8.

The TDA2004 must be mounted on an adequate heatsink. The maximum current drain is around 3.5A.

S. Williamson,
Hamilton, NZ. ($40)

Switching circuit for the M65830P digital delay

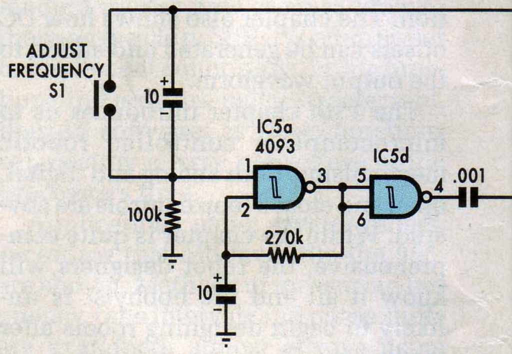
This circuit is designed to generate the delay time control data for the M65830P single chip digital delay. It interfaces to the serial transmitter section of the Stereo Simulator (SILICON CHIP, June 1996), providing a method of varying the delay time without using a microcontroller.

Looking at the block diagram, the 3Hz oscillator triggers a monostable multivibrator with variable pulse width. This monostable switches on a second oscillator running at 3kHz which clocks the counter. The final output consists of 3kHz bursts of varying length. Thus, the final count is determined by the monostable pulse width which is set by the delay control.

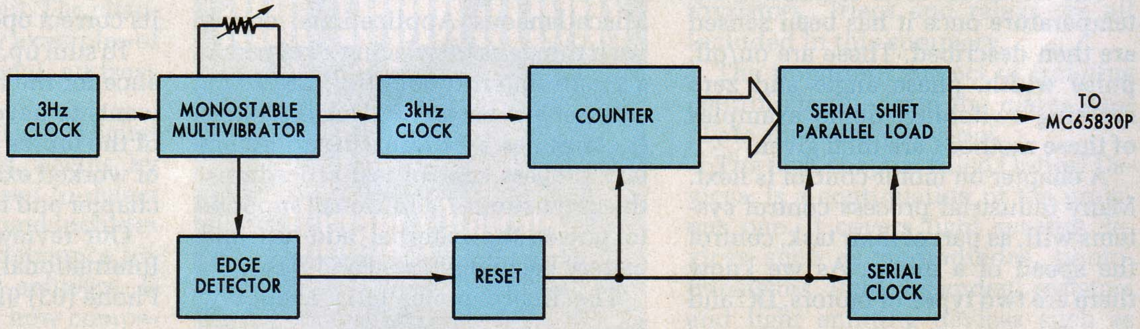
When the binary counter has reached the required value for the delay time (when the monostable output goes low), a falling edge detector activates the data send function of the remaining circuit. The six bits of delay information from the counter are latched in parallel into the shift register. The rest of the circuit transmits the data to the delay chip as in the Stereo Simulator.

Once this information has been sent, the binary counter with the delay time data is cleared and the serial clock goes back into reset mode until it is triggered by the edge detector again.

With a 3kHz counting rate, the entire process takes about 20ms. The circuit updates the delay three times every second while ever switch S1 is pressed. At this rate, the user should not notice any delay between adjusting the control and hearing the effect.



On the circuit, data is fed to IC3 by IC8, a 4024 7-bit binary counter which is clocked by IC5b & IC5c. IC5 is a quad NAND Schmitt trigger, set up to provide two oscillators. The first is set to 3Hz and the second to 3kHz. The



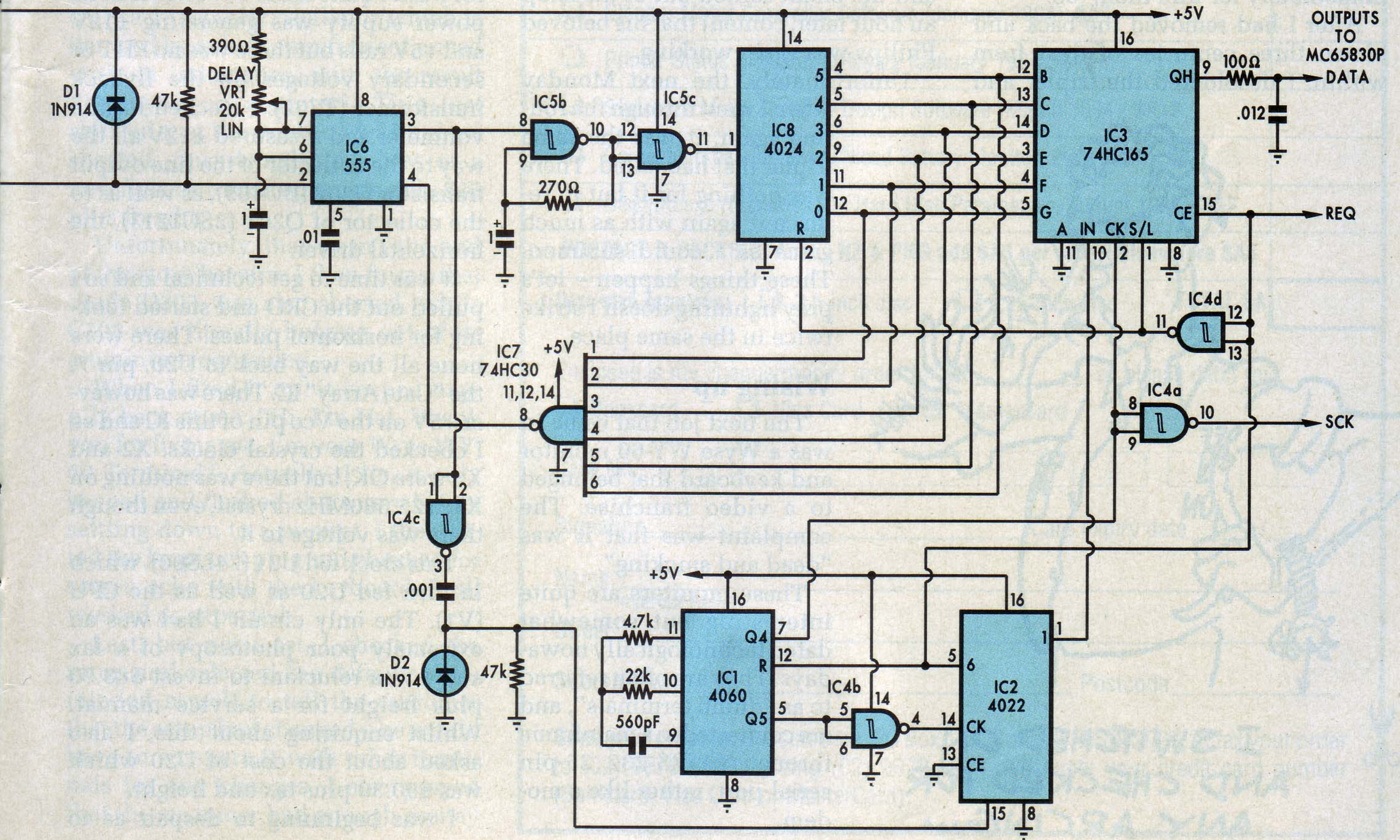
extra NAND gate following each oscillator provides signal inversion.

IC6 is a 555 timer configured in monostable mode with its output pulse width set by the 1μF capacitor and 20kΩ pot (VR1) at pins 6 & 7. The 390Ω resistor in series with VR2 sets the minimum pulse width. The monostable is triggered by the 3Hz clock and its output at pin 3 switches on the 3kHz clock while it is high. The clock input to IC8 consists of 3kHz bursts, three times a second. Thus, the count reached on IC8 is controlled by VR1, allowing the delay time to be continuously adjusted. It is updated each time the monostable is triggered.

Once the counter has reached the desired value, the data must be sent. This is triggered by the negative edge detector mentioned earlier. It is driven by the monostable output. When the monostable is high, the 3kHz clock is activated and so IC8 is counting. When the monostable returns to the low state, the clock stops and the edge detector generates a reset pulse to start the data send sequence of IC1, 2 & 3. Once the data has been sent, IC8 is cleared from the transition in the REQ line. The entire cycle repeats three times every second, as set by the 3Hz clock.

IC8 is a 7-bit counter but only six bits are used. To prevent the counter going over the 6-bit limit, IC7 (a 74HC30 8-input NAND gate) is used to reset the monostable when the first six bits are high. The inputs are connected to the outputs from IC8. The unused inputs must be tied high.

S. Eaton,
Frankston, Vic. ($60)



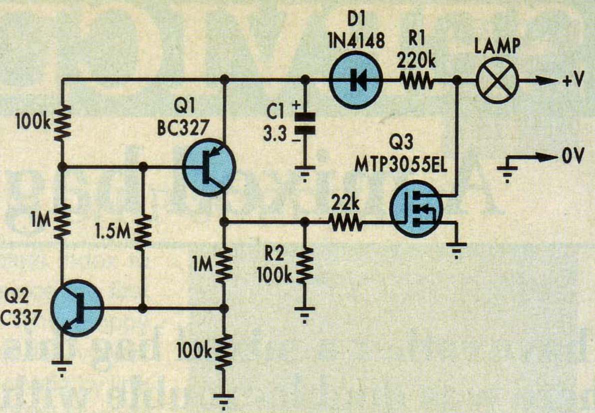
12V or 24V lamp flasher

This circuit will handle lamp loads up to 3A with no heatsink required for the Mosfet (Q3).

Q1 & Q2 function together as a breakdown device similar to a Diac. Up to a defined voltage, Q1 & Q2 are both off, as defined by the two 100kΩ and the 1.5MΩ resistors at their bases. When power is first applied, capacitor C1 has no voltage across it and Q1 & Q2 are both off. C1 is then charged via the 220kΩ resistor R1 until the voltage across it is sufficient to allow Q1 & Q2 to suddenly turn on. They then discharge C1 to the point where Q1 & Q2 turn off again. The cycle then repeats continuously and the pulse waveform at the collector of Q1 is used to turn FET Q3 on and off.

Capacitor C1 should be a plastic dielectric type. Resistor R1 determines the off time for Q3 while resistor R2 determines the on time.

G. La Rooy,
Christchurch, NZ. ($30)



SERVICEMAN'S LOG

A mixed bag of trouble & strife

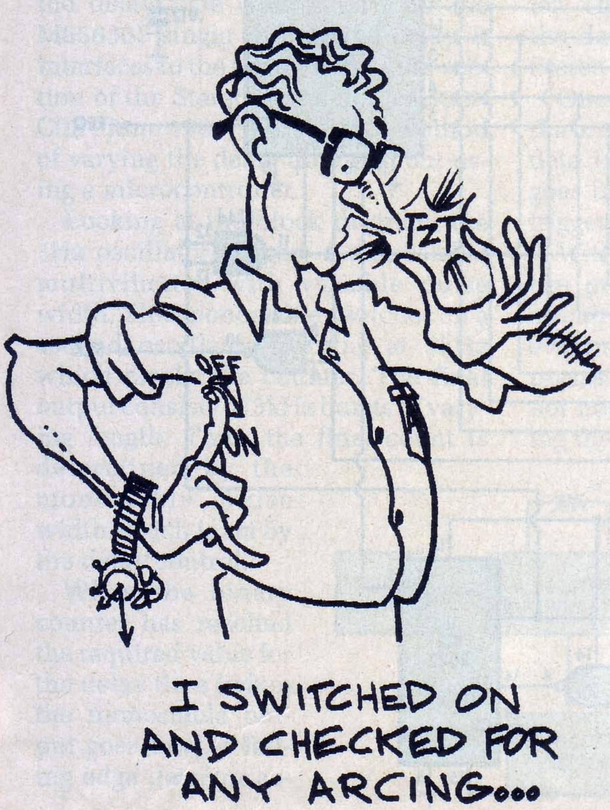
I have rather a mixed bag this month. First, there was double-trouble with a tripler, then I encountered a tricky Wyse monitor and finally, an NEC TV wouldn't stop whistling at me.

The day started badly when the kind and gracious gentleman of last Saturday returned on Monday with his ancient Philips TV set and cast unkind aspersions on my technical expertise by groaning that it had only lasted one hour. I put a brave face on it and told him to wait while I attended to it immediately.

This was a 13-year old KT3 Philips which had come in pulsating on Saturday morning and out of the generosity of my heart I had worked on it immediately for him then, too.

After I had removed the back and blown three centuries of dust from within, I desoldered the tripler and switched the set on. The sound forthcoming was indeed music to my ears, so I fitted a new (Philips-brand) tripler and checked the set out for dry joints, particularly around the vertical output and east-west transistors and the flyback transformer.

I also cleaned around the EHT ultor cap and applied silicone rubber to all the connections. On completion, I switched on and checked for any arcing before looking at the focus, brightness and greyscale. All was in order, and the client sallied out of the shop an hour later, content that his beloved Philips was again working.



Unfortunately, the next Monday when I went through the routine again, it was the same tripler that had failed. There was nothing for it but to replace it again with as much grace as I could summon. These things happen – let's pray lightning doesn't strike twice in the same place.

Wising up

The next job that came in was a Wyse WY-60 monitor and keyboard that belonged to a video franchise. The complaint was that it was "dead and smoking".

These monitors are quite interesting but somewhat dated technologically nowadays. They are often referred to as "dumb terminals", and are connected to a mainframe through an RS-232 25-pin serial port, rather like a modem.

The problem is that everything about them is expensive and they use only Wyse dedicated technology. This terminal has a green phosphor CRT (some have orange) and is controlled from the mainframe using the XENIX System V operating system (circa 1987).

Unfortunately, most people using this system are now faced with a difficult decision. Do they dice a system that uses maybe five or more dumb terminals and put in a brand new network costing tens of thousands of dollars, or do they get their ancient (in computer terms) equipment fixed? The only bright spot is that Wyse parts are easily obtainable, even if they are expensive.

Access to the main board isn't too bad once the back cover is removed and it didn't take long to see that the set wasn't quite dead. The switchmode power supply was generating ±12V and +5V rails but there was no EHT or secondary voltages on the flyback transformer (T202). I reached for the voltmeter and measured ±12V all the way to the collector of the line output transistor Q202 (BU405), as well as to the collector of Q201 (2SC1213), the horizontal driver.

It was time to get technical and so I pulled out the CRO and started looking for horizontal pulses. There were none all the way back to U20, pin 7, the "Gate Array" IC. There was however +5V on the Vcc pin of this IC and so I checked the crystal clocks. X2 and X3 were OK, but there was nothing on X1, a 25.580MHz crystal, even though there was voltage to it.

This clock fed U21 (74LS00), which in turn fed U20 as well as the CPU (V1). The only circuit I had was an extremely poor photocopy of a fax and I was reluctant to invest $88.90 plus freight for a service manual. Whilst enquiring about this, I also asked about the cost of U20 which was $50.30 plus tax and freight.

I was beginning to despair as to

what to do when I had a stroke of real luck – another identical monitor came in but with a different fault. This was intermittently displaying lines and characters on the screen. I decided to fix this one first and then use it to donate parts to the other for checking purposes.

By gently tapping the chassis, it didn't take me long to discover several dry joints around IC U19, the "Fonts" character generator. After soldering it up, I reconnected the DB25M loopback plug with pins 2 and 3 connected, in order to display the characters on the screen as I entered them on the keyboard.

In short, I gave it a thorough workout and it passed all my tests with flying colours.

Now that I had one working dumb terminal, I could resume work on the first. First, I swapped the crystal and ICs U20 and U21 but to no avail. However, when I swapped the EEPROM (U6), I began to get a pulse on the horizontal sync line but the problem was now in the horizontal output stage. The CRO reported severe ringing on the collector of the line output transistor and it was getting very hot.

I removed the flyback transformer and checked the winding between pins 3 & 4 with a shorted turns tester (basically a 15.625kHz oscillator which is damped by a short circuit or enhanced with an inductance, with the result displayed on a meter). This test showed that the winding was indeed shorted. Surprisingly, the cost of a new flyback transformer was only $25 plus freight.

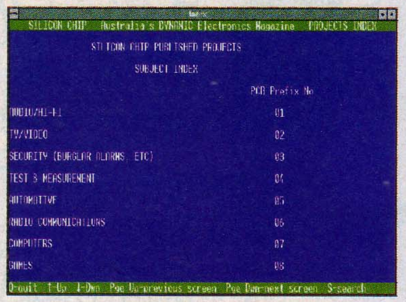
Unfortunately, that wasn't the end of the story because I then found that diode D203 was also shorted, while C208 was literally bulging out of its aluminium container.

When I fired it up, it beeped happily back at me: "Hi, I'm Hal. Thank you for fixing me. I'm your Wyse WY-60 Terminal". Actually, I lie, it only beeped and flashed characters before settling down to a prompt. I then fitted the loopback plug and checked for screen echo with the keyboard. It all worked as expected.

Last, but not least, I checked the setup and selected the defaults. I reminded myself to tell the customer that the setup had changed – he would have to compare it with other terminals for any changes. I also prayed that the customer had enough money

SILICON CHIP

SILICON CHIP SOFTWARE



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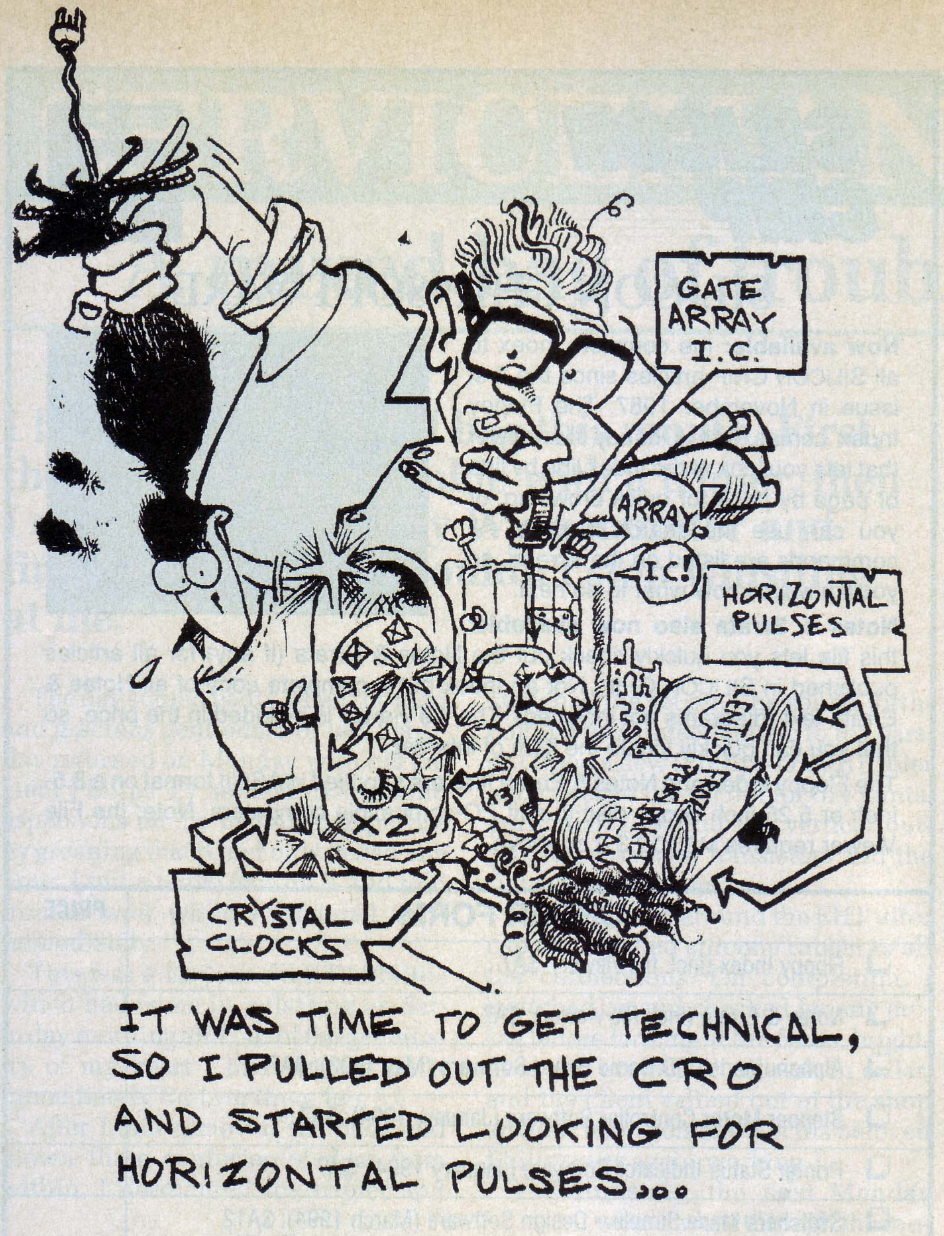
Suburb/town ______________________________ Postcode__________

Send your order to: SILICON CHIP, PO Box 139, Collaroy, NSW 2097; or fax your order to (02) 9979 6503; or ring (02) 9979 5644 and quote your credit card number (Bankcard, Visa Card or MasterCard).



to pay for all this, as it had taken quite some time!

The whistling NEC

The phone rang and an elderly gentleman asked whether I would be so good as to attend to his TV set which was on "the blink". It took a little coaxing to find out that it was an NEC N-4830 with two problems. First, it was making a whistling noise with associated patterning lines on the picture. Second, it was making a rather bizarre "bop-bop" noise on standby.

Because the fellow was 85 years of age and because I thought I knew all there was to know about this Daewoo C-500 chassis, I arranged to fix it in his home.

Despite his years, the customer was very sprightly and his fault description was fairly accurate. Unfortunately, access to the TV set was fairly poor and great care was required to avoid knocking over the entire collection of family photos and china ornaments.

The serial number plus a visual examination of the power supply quickly established that this had been a Series 5 production. This meant that a few modifications were required to bring it up to the current Series 7 specification, as briefly discussed in the Serviceman's Log for March 1996.

To recap, this particular model has an inherent weakness in the power supply. It uses a 10-pin switching regulator IC (I801) and this can overheat and fail, taking a lot of components with it.

The failure is not the fault of the IC itself but in the associated circuitry and a modification sheet has been issued to cover this.

In this case, the whistling noise was coming from the vicinity of the power supply but the regulator IC was still OK. The set had never been repaired before and two small electros, C808 and C810, were looking their age. I carried out the recommended modifications, replaced these two electros and soldered any suspicious dry joints.

One of the electros had me puzzled, however. The circuit showed both as being 10µF and yet C808 was actually marked 0.47µF. Perhaps this was the reason the set was playing up but if so surely it would have had these symptoms from new, which it hadn't. In any event, I found I had fixed the loud motor-boating noise on standby, but the patterning and whistling were still there.

I was disappointed by this and so, with my ego suitably chastened, I dived in again and examined the entire chassis for possible problems. But although I found and fixed many suspicious joints, the problem persisted. It was time to get serious.

The B+ rails all measured correctly and, apart from the whistle from the power supply and the line patterning, everything else worked. The pattern consisted of lines and a succession of horizontal curves but it was the whistling noise that was the most alarming. It didn't have a consistent pitch and it sounded as though the power supply was running roughly and could perhaps fail at any moment.

I was on the point of giving up and telling my octogenarian friend that it would have to go to the workshop, when inspiration struck me (it's amazing what the thought of having to shift a TV set down three flights of stairs can do). I put my brain into gear and measured the rectified B+ from the bridge rectifier to the main electro C807 (120µF 400VW). Although this voltage is not marked on the circuit, I expected a reading of about +340V but it actually measured +295V.

I didn't have a 120µF 400V electro with me and so I connected an old 100µF capacitor from the toolbox precariously across C807 and switched on. Hooray! It did the trick, the B+ rail came up, the patterning was gone and all was silent.

I told the gentleman I would be back the next day with the right part. Well, nearly. The nearest value I had was a 220µF 105°C 400V unit which was the same physical size as the original. I installed it as promised the next day. Interestingly, the old electro looked pristine even though it was definitely faulty. **SC**

APRIL SPECIALS

* SPECIAL PRICES VALID UNTIL APRIL 30TH

WIN A TRIP FOR 2 TO SOUTH AMERICA

FLYING

AEROLINEAS ARGENTINAS

JUST IMAGINE, YOU AND YOUR PARTNER OR FRIEND ON YOUR WAY TO A HOLIDAY OF A LIFETIME, COURTESY OF JAYCAR ELECTRONICS.

This fabulous trip includes full return airfare for 2 people on Aerolineas Argentinas. Also included: •7 days and 9 nights trip duration •Visit Buenos Aires, Iquazo and Rio De Janeiro •Twin share accommodation in standard Hotels with private facilities •All breakfasts •Meeting and transfers by coach in each centre •English speaking local guides •Local service charge and taxs included •Passport and Visa required •Holiday must be used by end of June 1997 •Holiday value $5,000 •Drawn on May 5th 1997

How to enter:

Store Customers: Simply spend $20 or more at any Jaycar Store in April for one chance.
Mail Order Customers: Every mail order will be automatically entered into the draw.
Dealers: Jaycar dealers listed in our '97 Catalogue receive one chance for every $100 spent.

SENSATIONAL SCOOP PURCHASE

TELKO SECURITY+ PLUS INTERIOR ALARM DEAL

This alarm has a built-in passive infra red (PIR) detector and 100dB piezo screamer. To arm and disarm, you simply enter your selected security code of 1 - 12 digits on the keypad. Can be mounted on a wall, or sit on a bookshelf. There is also a panic button for emergencies. It's 9 volt battery operated (battery not included), or from 240V with an optional adaptor - use Cat. MP-3006 $15.50. When run off 240V power supply keypad is illuminated. Its also expandable, extra PIRs, or reed/magnets can be added to NC terminals. Also includes 2 deterrent stickers. Unit size: 137(H) x 80(W) x 53(D)mm. Ideal alarm for home units, garages, caravans, boats, office etc, etc. It can sound a chime instead of a siren, so could be used as an announcer in a shop or office. Scoop Purchase We have purchased these as distress stock & can offer at a much reduced price to what they are currently selling for.

BONUS
With each purchase select either a Vibration Door Alarm Chime Cat. LA-5170 or a Window Door Magnetic Alarm Cat. LA-5165 - FREE

Cat. LA-5150 Normally Around $79 **Only $49.95**

TELKO SECURITY + PLUS INTERIOR ALARM DEAL

This kit consists of the Cat. LA-5150 alarm unit as described on left and also includes a 120dB siren with 15mt. of cable prewired & the mains power supply. The power supply and siren are both prewired with plugs and socket for easy installation.
Features: •Digital keypad arm / disarm control •Infrared motion detector up to 20 mts. x 110° •External 120dB siren •Emergency panic button •Pre-alarm tone •Lighted keypad •15m of siren cable include •Expandable

BONUS
With each purchase select either a Vibration Door Alarm Chime Cat. LA-5170 or a Window Door Magnetic Alarm Cat. LA-5165 or 1 of each FREE

Cat. LA-5155 Normally Around $169 **Only $99.95**

TELKO WINDOW / DOOR MAGNETIC SENSOR ALARM

This small alarm is designed to be mounted on a window or door. When the door / window is opened, a built-in 90dB alarm sounds. Its very compact and has an on/off switch on the body. If a burglar forces a window open and the alarm sounds, there is a very good chance the burglar will leave. If you want to open the window, simply turn it off. Also ideal for putting on cupboard doors, Hi Fi cabinets etc, to keep kids out! Size: 64(H) x 32(W) x 20(D)mm. Colour-white. Supplied with 2 alarm stickers, double sided adhesive tape and screws.

Cat. LA-5165 Normally $19.95 **Only $9.95ea**

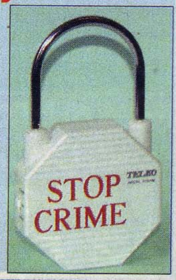
TELKO PROGRAMMABLE ENTRY ALARM / CHIME

This unit simply mounts on a door or window. When the door or window is opened the unit either chimes, or the siren goes off. It is switched on/off by a keypad and there is also a panic button for emergencies. Includes 2 warning stickers. This unit can be used for 2 different purposes: (1) Mount it on the front door of a shop, or office to advise someone has entered the establishment. It sounds a pleasant chime. (2) Mount it on a door and the siren will sound if its opened. This door could be your front door, garage door, shed door, caravan door, boat hatch, a room in your house you want to keep the kids out of etc, etc. Supplied with clear instructions. Requires 3 x AAA alkaline batteries (not supplied). Uses magnetic sensor switch for contacts. Size: 132(H) x 80(W) x 28(D)mm.

Cat. LA-5160 NORMALLY $49.50 **Only $24.95**

WAY BELOW NORMAL PRICES

TELKO VIBRATION DOOR / CHIME / ALARM



This unit simply hangs on the door knob inside a room. When the door is opened or shaken it will "sound". There are 2 sounding settings - chime and alarm. The chime setting is good for doctors, dentists, offices etc, to advise when someone enters. In the alarm mode, there is a piercing alarm sound. Operates from a 9V battery (not supplied). Includes 2 alarm stickers.
Cat. LA-5170

Normally around $19.95 **Only $7.95**

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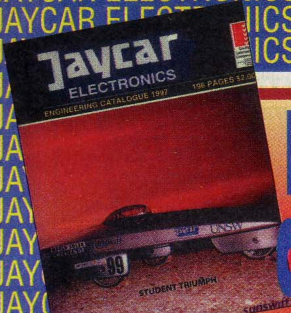


NEW CATALOGUE LAST MONTH!!!

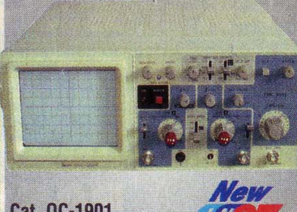
RECORDABLE CD's

Quality KAO Brand.

Cat. XC-4710

April Only $16ea or 10 For $150

35 MHZ DUAL TRACE CRO



New IN 97

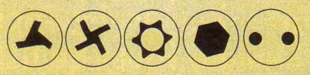
Cat. QC-1901
With 2 probes

Only $799

THE "FULL HOUSE" POWER DRIVER BIT SET

New IN 97

All the weirdo driver bits in one go!! -The set consists of 32, of the driver bits that you don't normally see. You don't get any slotted, Phillips or Posidrive bits. You do get: •4 x Tri - wing, size 1, 2, 3, and 4 •9 x Torx (tamperproof), size T8, T10, T15, T20, T25, T27, T30 and T35 •4 x Pin drive (snake), size 4, 6, 8 and10 •6 x In - Hex (allen), *metric, size 2, 2.5, 3, 4, 5 and 6 •6 x In - Hex (allen), *imperial size 5/64", 3/32", 7/64", 1/8", 9/64" and 5/32" •3 x Torque Set, size 8, 9 and 10. With this you get a hex driver with magnetic retainer, all in a nifty plasticy - rubber holder that is smaller than a deck of cards! (67 x 45 x 30mm). you will never get stopped by a wacko screw ever again!!



Cat. TD-2035 **$29.95**

JC 30 COMPACT SPEAKER KIT

Crossovers shown are representative only

REFER EA FEB. 97 This speaker kit came about because we purchased a quantity of high quality cabinets from a woodwork factory who had made them for a speaker manufacturer who went broke. We purchased the cabinets at a fraction of their build cost and designed the speaker kit around them. The cabinets are extremely high quality. They are made from 19mm MDF board which is covered in an unfinished real wood veneer and needs to be stained and/or lacquered. There is a small amount of construction work required to complete the cabinets and this is reflected in the low price of the kit. Specifically this work is: rear port hole needs to be slightly enlarged, speaker grills need to be built from 4 pieces of pre-cut hardwood beading supplied and grill cloth needs mounting. These jobs should not pose much of a problem to those with a modest level of woodworking skills. The fundamental quality of the enclosures will make the effort worthwhile. There are two choices of cabinet wood finishes available - Jarrah (dark) and Blackwood (light). We have a much larger quantity of Jarrah finish available. We reserve the right to to supply Jarrah when the Blackwood stocks are exhausted. THE SPEAKER KIT - the woofer used are our Re/Sponse Carbon Fibre Drivers and the tweeters are Vifa D19. The crossovers are pre built. The total impedence is 4Ω, which is not a problem for most amplifiers and they could even be used in a car stereo system. Power handling is 80WRMS.

SPEAKER KIT

Includes: •2 x 6" carbon fibre woofers •2 x Vifa D19 dome tweeters •2 x pre built crossover networks.

Cat. CS-2590 **$229 Pr**

CABINETS

Includes: •2 x pre built cabinets •Grill frame pieces •Speaker cloth •Rear terminals •Innerbond •Ports •Speaker grill clips •Wire.

Jarrah Cat. CS-2592
Blackwood Cat. CS-2594 **$169 Pr**

Normally $398 Pr

BUY SPEAKER KIT AND CABINET KIT TOGETHER

Pay Only $349 Pair

Quote from Rob Evans - Electronics Australia

At an all up kit price of just $349 a pair, these new two-way kit speakers from Jaycar may well represent about the best value-for-money around in high performance bookshelf loudspeakers.

JAYCAR GAS SOLDERING IRON WITH PIEZO IGNITION

New IN 97

Brand new model for 1997. Now with built in piezo self igniter and metal body. This new generation soldering tool has an all new catalyst, which is much less likely to burn out, is easier to ignite and gives a uniform heat output. To start, simply turn on the gas and push the starter button. The solder tip assembly is remov-eable, which allows you to use the tool as a flame torch. Tool is supplied with needle point soldering tip, cap to protect the unit in tool boxes, small stand with cleaning sponge and a small roll of emergency solder.

Cat. TS-1725 **$39.95**

MAINS LEAD BARGAIN!!!

We have made a surplus stock purchase of some rather short 3 pin mains leads. Short leads are used for wall mount airconditioners. They are Burton brand and the ends have spade lugs attached.

Limited quantity available.

New IN 97

TYPE 1
Length 470mm
Cat. PS-4111 **$0.75 ea**

TYPE 2
Length 630mm
Cat. PS-4112 **$1.00 ea**

MINI FEMALE SPADE LUGS

New IN 97

We have made a scoop purchase of some insulated mini female spade lugs. The spade diameter is 3.2mm wide and they are commonly used on tweeters and in Australian telephone plugs.

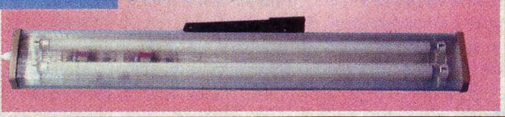
Pkt of 20 Cat. PT-4540 **$1.95**
Pkt of 100 Cat. PT-4541 **$7.95**

12 VOLT 26 WATT TWIN TUBE FLUORESCENT LIGHT

New IN 97

It has two 13 watt fluro tubes and can be screwed to a wall. Includes a push button On/Off switch. Size - 600(L) x 76(W) x 25(D)mm. Current draw is a very low 1.25A.

Cat. ST-3021 **$29.95**



CCD CAMERA

New IN 97

Great price!! 1/3" B & W camera with 92° viewing angle and 6 infra red leds for illumination. See 97 Cat. page 169.

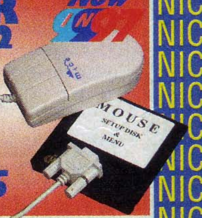
Cat. QC-3450

$169.50

SUPER MOUSE 2

New IN 97

Cat. XM-5110
Save $5.00
Only $14.95



BENCH TOP WORK MAT

A3 size. Durable PVC cutting mat.

Cat. HM-8100

New IN 97

$14.95

"FLIGHT CASE" STYLE TOOL BAG

Styled on the case that pilots and aeroplane crews use. See 97 Cat. page 95 for full details.

Cat. HB-6372 **$89.95**

New IN 97

ULTIMATE "SWISS ARMY" GADGET?

New IN 97

Made of stainless steel. A quality product. See 97 Cat. page 104 for full details.

Cat. TH-1902 **$39.95**

FREECALL FOR PHONE ORDERS 1800 022 888

ALL JAYCAR STORES ARE NOW ON EFTPOS!

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SAME DAY DESPATCH FOR MOST MAIL ORDERS

FIND BURIED TREASURE WITH GARRETT METAL DETECTORS

We have made an amazing scoop purchase of 2 famous Garrett metal detectors. There is a strictly limited, small quantity of each available and they will not last long. You may have seen these two detectors advertised recently. We have taken $200 off advertised prices of each. Be warned - be quick!!

Treasure Ace Plus

ONLY 30

Treasure Ace automatically ignores trash and finds deep treasure, well beyond more expensive competitive instruments. Detection features: •Deep search circuitry •Full range adjustable discrimination - ignores foils, nails, bottlecaps, pulltabs and other junk •3 initial preset discrimination levels •Automatic ground balance •Adjustable depth / sensitivity •Fast / slow sweep rate •Automatic battery check •Speaker and headphone jack
•Supplied with instruction video cassette.

Cat. XM-3000 Was $595 Save $200 **Now $395**

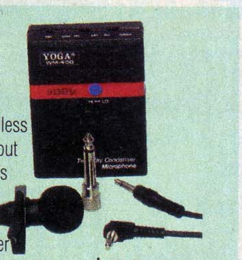
GTA350 ONE TOUCH DETECTOR

ONLY 14

Microprocessor controlled and features sensitive deepseeking circuitry that has proven itself by countless treasure discoveries all over the world. Features: •Fully automatic one touch operation •18 notch graphic target analyzer •18 notch coins preset / adjustable treasure mode •One touch reset to factory settings •Adjustable audio and depth / sensitivity •Stereo headphone jack •Supplied with instruction video cassette.

Cat. XM-3010 Was $995 Save $200 **Now $795**

TIE CLIP WIRED & WIRELESS



This mic works extremely well in both FM wireless and wired mode. It consists of a black box (about the size of a packet of 20 cigarettes) which clips on your belt or pants. This box accepts the lead in from the tie clip microphone, holds the batteries and the cable to the amplifier runs from here. Cat. AM-4078

Was $49.95
Now $37.95 Save $12.00

MICROPHONE HOLDER

Unique universal holder. It has a powerful spring loaded clamp which will fit almost all microphones. Standard 5/8" x 27 thread.

Cat. AM-4100 Was $6.95
Save $3 **Now $3.95**

ILLUMINATED SAFETY BELT

WHAT A FLOP

Be more visible at night. Has EL light across back of belt. Simply clip on over clothing.

Cat. SL-2880
Was $24.95
Save $14.95 **Now Only $10.00**

HOT-SOL SERVICE KIT

This kit comes with a range of accessories and it's all housed in its own case.

Includes:
- •1 x Hot-Sol Butane GasTool
- •1 x Protective Cap
- •1 x Non-slip stand with sponge •1 x Torch Tip which gives a flame •1 x 2.4mm Soldering Tip •1 x Roll Solder •1 x Hot Knife Tip •1 x Case which holds everything •1 x Hot Blow Tip for shrinking heatshrink tubing •1 x Scoop for feeding tubing to hot blow tip.

Cat. TS-1702 Was $49.95
Now $39.95 Save $10

HOT-SPOT UPRIGHT GAS SOLDERING IRON

Includes 3 soldering tips, polyfoam cutting tip and hot knife tip.

Cat. TS-1420

Was $49.95 Save $15
Now $34.95

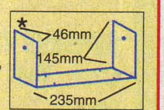
ECONOMY PIEZO TWEETER

Ideal replacement or add on to an existing system for more highs. Use with or without crossovers.
•Frequency resp 3.5k to above 20 000hz.
•Sensitivity average 94db 1W/1m •Power- 75 watts peak intermittent.

Cat. CT-1905 Was $12.50 Save $5
Now $7.50

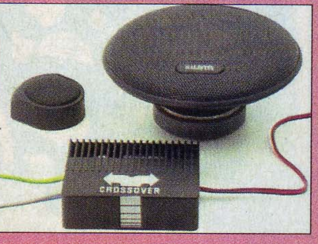
SPEAKER MOUNTING BRACKETS

Consists of two steel brackets, dimensions as per diagramme*, two 3mtr. lengths of fig.8 speaker cable, 4 bolts with knobs for screwing into non existant speakers, 4 pieces of sticky one side felt to avoid scratching non existing speaker and 8 x bols, nuts and washers.



Cat. CW-2800
Was $3.95 **Now $2.50**

CAR SPEAKER KIT SYSTEM

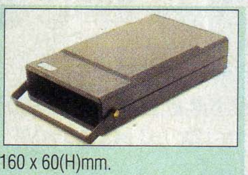


AMAZING SCOOP PURCHASE Consists of 2 x 6.5" bass enclosed poly[ropylene woofers, 2 x 1" dome tweeters and 2 x 2 way high power crossovers.
•Power handling: 70WRMS (180WPMPO)
•Impedance: 4ohms
8Freq. response: 60Hz-22kHz •Sensitivy: 91dB/1W/1M. Comes complete with mounting screws and speaker wire. This system retails in the market for over $150.00

Cat. CS-2276

Was $99.00 Limited Quantity
Sellout Price $75 Pr

CASE WITH HANDLE



This quality case was designed to hold a disk drive. It is ideal for test equipment. There is a handle supplied which attaches to one end and also supplied are metal front and rear panels. Colour is black. Size; 270 x 160 x 60(H)mm.

Cat. HB-5945 Was $19.95 **Sellout Price $10**

VHS - C VIDEO HEAD CLEANER

•Goldring wet type head cleaner •Supplied with tape and bottle of cleaning fluid

Cat. AV-7012

Retail $29.95 **Now Only $4.95**

CAMCORDER ACCESSORY BRACKET

•Robust aircraft alloy construction •Provides 1 or 2 accessory shoe mounts •Functions as a sturdy hand grip •Mounts easily onto any tripod or camcorder
•Built-in liquid level indicator •Screws into camcorder tripod socket

Cat. AV-7000

Retail $40.95 **Now $7.95**

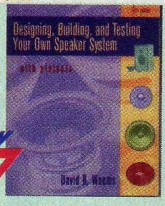
3MTR. SCART TO SCART VIDEO LEAD

•3 metre lead with 21 pin scart to scart plug

Cat. AV-7011 **Only $7.95**

Designing, Building & Testing your Own Speaker System with Projects

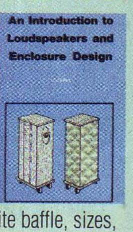
New 97



Build your own low-cost speaker system. This edition features: basic speaker theory, types and functions of speaker enclosures, closed box and ported box speaker construction, crossover networks and filters, PA systems and musical instrument speakers, speaker equipment selection, speaker placement and acoustics, speaker testing & troubleshooting. 214 pages 187 x 233mm.NEW 4TH EDITION

Cat BT-1324 **$39.95**

Introduction To Loudspeakers and Enclosure Design



This book explains the principles of speakers and discusses alternative drivers such as electrostatic, push pull, piezo and more. It discusses cabinets from infinite baffle, sizes, damping, enclosure design, to horns, transmission line, resonances and materials. It explains about cross-over networks and which parameters really matter. Softcover, 148 pages, 110 x 176mm.

Cat. BB-7032 **$12.95**

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JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

POCKET SAMPLER KIT FOR PC'S

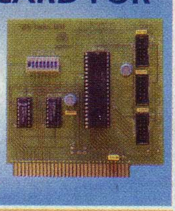
Ref. EA Aug. 96.
Connect to your PC's parallel port, giving readings with 8-bit resolution over 0-2V or 0-20V sampling range.
Cat. KA-1787
Only $29.95

PC'S-BUS SLEUTH KIT

Ref. EA Oct. 96.
Invaluable kit for PC technicians and hobbyists installing sound, network and modem cards or multimedia onto their PC's.
Cat. KA-1788
April $34.95

24 LINE 1/0 CARD FOR PC'S (KIT)

Ref. EA Nov. 96.
This card plugs into a spare ISA slot on your motherboard to provide a total of 24 digital lines.
Cat. KA-1789
$42.50



REMOTE CONTROL EXTENDER

Ref. SC July 96.
Use a remote control from another room. See 97 Cat. Page 11.
Cat. KC-5209
$24.95

PRE PROGRAMMED REMOTE CONTROL

New 97

Includes LCD display. Great price.
Cat. AR-1700
Only $29.95

ALSO AVAILABLE
- Programmable Remote Control
Cat AR-1710 **$43.95**
- Programmable & Pre Programmed
Cat AR-1705 **$69.95**
- Full LCD Screen Remote Angel
Cat AR-1720 **$169.50**

MULTIMEDIA DRAWER

New 97

Stores 95 x 3.5" disks, or data cartridges or MO disk cartridges. Lockable, with dividers. Low price. Cat XC-4675
Only $19.95

3.5" DISKS (IBM FORMATTED)

New 97

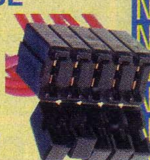
Pkt. 25 Cat XC-4740
$12.95

Pkt. 25 (5 colours)
Cat. XC-4742
$14.95

30A INLINE STACKABLE BLADE FUSE HOLDER

New 97

Make a bank of them. Great for cars.
Cat. SZ-2045
$2.95ea.



BLUE LEDS

New 97

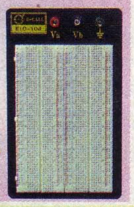
New range. Much higher light intensity for 1997.
Specifications for both sizes:

Forward Voltage	4.5V (5.5V max) @ 20mA
Reverse Current	100μA
Peak Emission Wavelength	430nm
Viewing Angles	3mm - 20° 5mm - 16°
Luminous Intensity Max @ 20mA	3mm - 90mcd 5mm - 150mcd

Size	Cat	Price
3mm	ZD-1746	$3.95
5mm	ZD-1726	$3.95

LOWER PRICES ON BREADBOARDS

1660 TIE POINTS
Cat. PB-8816
Was $44.95
Now $29.95



FRIDGE MAGNETS

A packet of 100 13(W) x 9(L) x 4(D)mm. Craftwo
This magnet is ideal as the mag
your fridge mounted novelty or message.
Cat. TH-1876
Pkt of 100 $4.95

GOOSENECK MICROPHONE

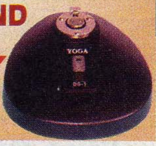
New 97

See 97 Cat. page 169.
Cat. AM-4086
$59.95

TABLE MIC STAND

New 97

Cat. AM-4088
$44.95



12V HALOGEN GLOBES

New 97

TWO LAMP SIZES AVAILABLE - 35 & 51MM DIA.

51mm 20 watt
Cat. SL-2730 **$4.95**

51mm 50 watt
Cat. SL-2732 **$4.95**

35mm 20 watt
Cat. SL-2733 **$4.95**

35mm 35 watt
Cat. SL-2734 **$4.95**

BASE TO SUIT BOTH
Cat. SL-2735 **$2.95**

DOWN LIGHT HOLDER
White in colour, includes base.
50mm
Cat. SL-2738 **$4.95**
35mm
Cat. SL-2740 **$4.95**

TRANSFORMER FOR MAINS OPERATION
240V AC to 12V AC at 5.25 AMP (63VA), with mains lead.
Cat. MP-3050 **$24.95**

MINI GLUE GUN

New 97

240V mains operated. Amazing price!
Cat. TH-1990
$14.95

SPARE GLUE
Cat. TH-1991
Pkt 6 **$2.20**

JAYCAR FANS

New 97

SIZE	CAT	PRICE
25mm 12V DC	YX-2500	$24.95
40mm 12V DC THIN	YX-2503	$17.95
40mm 12V DC	YX-2502	$19.95
60mm 12V DC	YX-2505	$19.95
80mm 12V DC	YX-2512	$18.50
80mm 240V AC THIN	YX-2509	$27.50
80mm 240V AC	YX-2510	$27.50
80mm 240V BALL BEARING	YX-2508	$34.95
120mm 240V AC THIN	YX-2516	$27.50
120mm 240V AC	YX-2514	$27.50
120mm 240V BALL BEARING	YX-2517	$34.95
150mm 240V AC	YX-2520	$79.50

DIGITAL CAPACITANCE METER

Superseded model
0.1pf to 20,000uf.
Cat. QM-1572
Was $99.50
April **$79.50**
Save $20

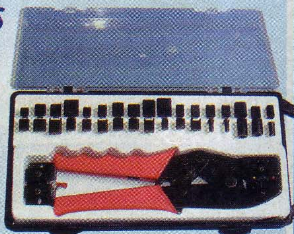
JAYCAR WHOLESALE

(02) 9743-5222

CRIMPING TOOL FOR INSULATED TERMINALS

Crimps insulated spade lugs, bullet, Y terminals etc..
Cat. TH-1928
$79.95

New 97



AA NI-MH 1.1 AMP BATTERIES

STANDARD TYPE Cat SB-2455
Was $5.95 Now **$4.95** Save $1.00

WITH SOLDER LUGS Cat SB-2457
Was $6.25 Now **$5.25** Save $1.00

6 WAY POWER OUTLET WITH MAINS FILTER

Amazing new price for 1997. Not only is it a six way power board, it incorporates: • Voltage Surge Protections • Noise Rejection Filter Network • Spike Protection • Safety Circuit Breaker. Ideal for running your computer gear, telephone, fax, answering machines, Hi Fi, video and TV equipment.
Cat. MS-4030 **$32.95**

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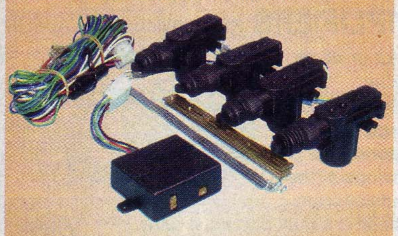
4 DOOR CAR POWER DOOR LOCK KIT



It consists of 2 master solenoids and 2 remote solenoids, relay and wiring harness. For full details see 97 Cat. page 75. **Cat. LR-8830**

Normally $89 Save $14

April $75.00

vifa P13WG 5" WOOFER / MIDRANGE

As used in JV40 and JV100 speaker kits. See 97 Cat. page 33 for full details.

Cat. CW-2104 **Normally $89.50**

April $59.50

Save $30.00

NEW CELLULAR TELEPHONE BATTERIES

New 97

Nokia 101/121
Nickel Metal Hydride NI-MH
1200mAH •Standby 30hr •Talktime 130min
Cat. SB-2555 **$49.95**

Nokia 2010
Nickel Metal Hydride NI-MH
1200mAH •Standby 24hr •Talktime 120min
Cat. SB-2564 **$45.00**

Motorola Microtac
Nickel Metal Hydride NI-MH
2100mAH •Standby 39hr •Talktime 170min
Cat. SB-2571 **$79.95**

Motorola Microtac Slim
Nickel Metal Hydride NI-MH
900mAH only 12mm thick •Standby 20hr •Talktime 85min
Cat. SB-2569 **$79.95**

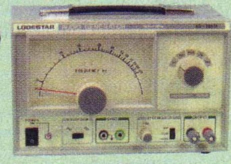
NEC P3
Nickel Metal Hydride NI-MH
1200mAH •Standby 24hr •Talktime 120min
Cat. SB-2581 **$49.50**

NEC Sportz
Nickel Metal Hydride NI-MH
Capacity 1200mAH •Standby 24hr •Talktime 120min
Cat. SB-2583 **$49.50**

Philips Fizz
Nickel Metal Hydride NI-MH
1800mAH •Standby 33hr •Talktime 150min
Cat. SB-2590 **$69.95**

RF SIGNAL GENERATOR

Cat. QT-2312
Was $289
Now $229
Save $60



SEE 96 CAT P32 FOR DETAILS.

AUDIO GENERATOR

Cat. QT-2310
Was $289
Now $229
Save $60

BUY BOTH FOR $439

JayTech 8 SECTOR ALARM DEAL

Ideal for larger homes. This system has our 8 sector panel and includes everything that a professional alarm installation company would install and charge around 800-$1000. Save a fortune by doing it yourself.

INCLUDES:	NORMAL PRICE
1 x 8 sector Jaytech panel	$139.50
1 x mains power supply	$21.50
1 x 1.2Ah backup battery	$28.50
3 x Micron pulse count PIRs	$89.85
3 x reed/magnet switches	$17.25
1 x strobe	$19.95
1 x metal siren cover	$29.95
1 x siren horn	$25.95
1 x internal siren	$19.95
2 x deterrent stickers	$4.00
100 m of 6 core alarm cable	$88.00
PAY	$484.40

Cat. LA-5455

Normally $349

April Only $299!!

Save A Further $50

"L" TYPE DRIVER SET

New 97

Need to get a screw in or out of a cramped space? Includes 10 bits :
•Slotted - 4mm, 5mm, 6mm. •Phillips - No.1, No.2. •Posidrive - No.1, No.2. •Torx - 10mm, 15mm, 20mm.

Cat. TD-2044 **$9.95**

OFFSET RATCHET DRIVER SET

Ideal for working around the car. Supplied with the following tips - 3 slotted, 2 Phillips, 2 Posidrive, 3 Torx, 6 socket bits.

New 97

Cat. TD-2045 **$16.95**

Car Subwoofer Cabinets

These two new low cost subwoofer cabinets are supplied in knockdown form. They need to be assembled, and finished. They are made using 18mm MDF, and the speaker hole, port and rear terminal holes are all pre cut. Each box is supplied with rear terminal, adjustable length ports (1 for 8", 2 for 10"), wood screws to screw box together, screws to mount ports and rear terminal, length of speaker cable from speaker to rear port and 1 pc speaker dampening material. You will need to screw/glue the box together, mount the driver etc. You can leave the box in an unfinished state, paint it or carpet it.

The boxes are specifically designed for car use. They are designed for our Jaycar Re/Sponse drivers, but can in theory, be used for other woofers providing they suit the enclosures.

We have made them as physically small as possible without compromising response, and to provide the maximum amount of punch and thump while maintaining efficiency.

8" Sub Woofer Cabinet

Cat. CS-2530 **$89**

This cabinet measures 540(W) x 290(D) x 290(H)mm when built.

New 97

Suitable Re/Sponse drivers are:

4Ω Polycone Cat. CS-2234		**$65.00**
Tuning Frequency	39Hz	
-3dB Frequency	39Hz	
Port Length	165mm for 66mm dia	
4Ω Carbon Fibre Cat. CS-2242		**$99.50**
Tuning Frequency	42.1Hz	
-3dB Frequency	40Hz	
Port Length	125mm for 66mm dia	

10" Sub Woofer Cabinet

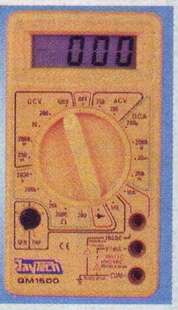
Cat. CS-2532 **$99**

This cabinet measures 540(W) x 340(D) x 340(H)mm. This cabinet will give deeper, louder bass than the 8", but you will need extra space. Combined with our 10" 4Ω Carbon Fibre Woofer (Cat. CS-2244 $149.50) can handle enormous amounts of power. Suitable Re/Sponse drivers are:

New 97

4Ω Polycone Cat. CS-2236		**$99.50**
Tuning Frequency	40Hz	
-3dB Frequency	40Hz	
Port Length	2 x 66mm ports at 228mm	
4Ω Carbon Fibre Cat. CS-2244		**$149.50**
Tuning Frequency	40Hz	
-3dB Frequency	39Hz	
Port Length	2 x 66mm ports at 225mm	

Digital Multimeter Under $20!



•3.5 digit •Transistor Test
•Diode Test •10A

Cat. QM-1500

Was $24.95

Only $19.95

SAVE ON VIFA D25 TWEETER

See cat page 32 for full details.
Cat. CT-2020

Was $69.50

April $49.50 **Save $20**

JAYCAR GIFT VOUCHERS AVAILABLE!!

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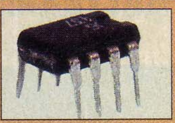
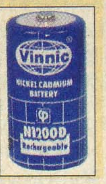
MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

IC SPECIAL



SN 75477P Pkt. 10
Cat. ZK-8865
Only $2.00

D SIZE 1.2AH NICAD



Cat. SB-2460
Was $5.95
Now $3.95
Save $2.00

SUBWOOFER AS USED IN NEW ELECTRONICS AUSTRALIA KIT

Refer EA March 1997. Build your own low cost sub woofer. Use your woodwork skills and our CW-2136 woofer. Power handling 120WRMS.
Cat. CW-2136
Only $69.50

IEC LINE PLUG TO BARE END

Cat. PS-4100
Was $6.50
Now $3.95

PHILIPS AD02110/SQ.8 MIDRANGE DISCONTINUED

Yes, Philips have discontinued their famous dome midrange. We have a small quantity left. This is your chance to grab a spare.
Cat. CM-2088 **Now $82.00**

8" 8Ω PA TWINCONE SPEAKER

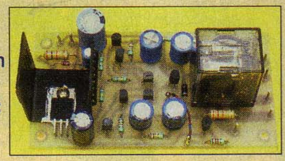
Power handling 10W RMS
Cat. CE-2326
Only $10 each

2 x 90WRMS CAR AMPLIFIER

See 96 Cat. page 61 for details.
Cat. AA-0430
Cat. Price $269
April $229
Save $40 This Month

UNIVERSAL LOUDSPEAKER PROTECTOR KIT FOR STEREO AMPLIFIERS

Refer: Silicon Chip April 97



New 97

This kit protects valuable loudspeakers from damage by monitoring the DC conditions at the outputs of your amplifier. If a fault occurs, a relay disconnects the loudspeakers before their voice coils heat up and burn out, or catch fire! As a bonus, it also has a delay at switch-on to eliminate dangerous thumps from the loudspeakers. This kit is designed to mate with any stereo amplfier, music or car sound system. The Jaycar kit is supplied short form with PCB, genuine 10A relay plus specified electronic components for both the internal version as described by Silicon Chip. A 9-12VDC plugpack is required if externally mounting the protector. See S/C April for full details
Cat. KC-5220 **Now $19.95**

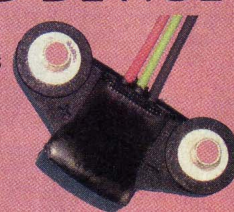
WIRED MULTI PIN PLUG / SOCKET

New 97

Heavy duty plug and socket with bullet type connectors. Pre wired with 18AWG wire. Extremely handy when cables need to be periodically unplugged.

Cat. PP-2030	4 Way	$4.95
Cat. PP-2032	6 Way	$6.50

HKZ101 HALL EFFECT VANE SWITCHED DEVICE



This device manufactured by Siemens in Germany consists of a Hall Effect semiconductor sensor separated across a small gap by a magnet. It is ideal as the commutator for an electronic ignition, however it has many other uses in other areas.See 97 Cat. for full details.
Cat. ZD-1900 **Was $46.95**
Now $29.95 Save $17

SQUARE CONE TWEETER

New 97

Ideal replacement low cost cone tweeters. Specifications:
• Power handling: 50WRMS system
• Frequency range: 2k - 16kHz • Crossover point: around 3 kHz .

Cat. CT-2002 **Was $7.95**
April $5.00 or 10 for $40.00

LOWER PRICES ON 1.1 A/HR. AA NI-MH RECHARGEABLES

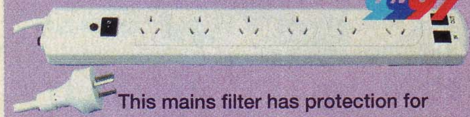
STANDARD TYPE:
Cat. SB-2455 Was $5.95 **Now $4.95**
WITH SOLDER TAGS:
Cat. SB-2457 Was $6.95 **Now $5.25**

12VDC TO 240VAC INVERTERS

140W:	Cat. MI-5036	$99.95
200W:	Cat. MI-5038	$159.50
300W:	Cat. MI-5042	$229.50
500W:	Cat. MI-5052	$379.00

6 WAY POWER OUTLET WITH MAINS FILTER AND TELEPHONE LINE PROTECTION

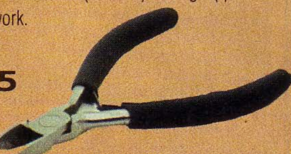
New 97



This mains filter has protection for telephone products - phones, modems, answering machines, cordless telephones, faxes. Ideal for protecting your computer and internet from spikes and surges. Features include: • 6 protected power outlets • In/out telephone sockets • Resettable circuit breaker • On/off switch with LED • Voltage surge protection • Built-in filter network • Thermal fuse for overload protection
Cat. MS-4035 **$44.95**

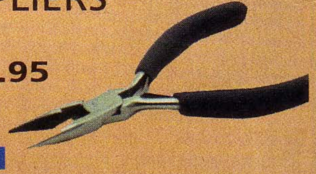
JAYTECH BUDGET CUTTERS

These 4.5" (110mm) cutting nippers are ideal for circuit board work.



Cat. TH-1882
was $9.95
$7.95

JAYTECH BUDGET LONG NOSE PLIERS



Cat. TH-1884
was $9.95
$7.95

LCD 'VERNIER' TYPE ENGINEERS CALIPER

This precision instrument is made out of surgical grade stainless steel. It features a 5 digit LCD display. The display will show readings in metric - 3 significant figures plus 2 decimal and in imperial - 2 significant figures and would you believe 3.5 decimal. The caliper can be rezeroed at any point on the scale.
Cat. TD-2082 New 97 **$99.95**

3 PIN PLUG PACK CASE

Make your own plug in power supplies with our new case. Case size is 95(H) x 47(D) x 55(W)mm. Complete with earth pin! Manufacturers, contact us for great prices.
Cat. HB-5900 **Only $5.95**

PKT 25 3.5" IBM FORMATTED HIGH DENSITY DISKS

Save even more! Less packaging means lower price. 100% error free, includes user labels, lifetime warranty. Don't pay $19.95.
Cat. XC-4740
ONLY $12.95

JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

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SAME DAY DESPATCH FOR MOST MAIL ORDERS

VIDEO SHOULDER STRAP

•Adjustable length - 880mm to1000mm •Padded foam centre section, nylon adjustable straps each end •Quick release locks allows strap to be easily removed •Use with video & 35mm cameras & binoculars Cat. AV-7026

Retail $25.95 **Now $3.95**

CAMCORDER CLEANING KIT

•Kit comes complete in carry box •Consists of: Wet/dry cleaner in cassette with fluid - Small battery operated mini vacuum cleaner which runs on 4AA batteries. Ideal for removing dust - Pkt. of 50 lens cleaning tissue paper - Cotton buds for hard to get places - Camera and camcorder spray lens cleaner and cleaning cloth Cat. AV-7040

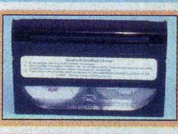
Limited quantity available

Retail $59.95 **Only $15**

CASSETTE DEMAGNETISER/CLEANER

•Head cleaning tape/demagnetiser in 1•Simply put tape in machine & it both cleans & demagnetises together •Supplied from bulk pack - no case Cat. AV-7042 **Only $1 ea**

8MM VIDEO DRY HEAD CLEANER TAPE



•It pays to keep your camcorder heads clean by using a video head cleaner. Cat. AV-7027

Retail $27.95 **Now $3.95**

8MM VIDEO CAMERA WET HEAD CLEANER

•With head cleaner tape & bottle of head cleaning solution •Camcorder heads need cleaning regularly Cat. AV-7038

Retail $34.95 **Now $4.95**

ELECTRIC FENCE - VERY LIMITED QUANTITIES AVAILABLE

Cat. No.	Description	Was $	Now $	Save
DE-6010	2KM Energizer	129.50	89.50	30.00
DE-6015	10KM Energizer	179.50	129.50	50.00
DE-6040	Wire join clamps Pkt.10	6.95	2.95	4.00
DE-6050	Gate handle	4.95	2.50	2.45
DE-6052	Gate anchor	2.65	1.00	1.65
DE-6055	Spring gate set	12.95	7.95	5.00
DE-6060	Poliwire 200mt.	26.95	16.95	10.00

METEX M3850 COMPUTER CONNECT

•Dual display •RS232 interface •Capacitance •Auto hold •Data hold •10 memory •Bargraph •Min/max display •Relative offset •Logic •20 •4000 count •Back light •Temp •40MHz freq •Auto/manual range

Cat. QM-1260 Was $239.50

Now $179.50 Save $60

4 AMP CAR BATTERY CHARGER Cat. MB-3530

Was $39.95 Save $10

Now $29.95

SAVE ON THESE JAYCAR KITS

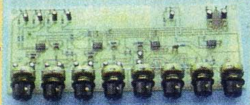
ECONOMY SURROUND SOUND

See 96 Cat. page 6.
Cat. KA-1773
Was $69.50
Now $39.50
Save $30.00

100W AMP MODULE

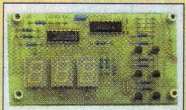
See 96 Cat. page 8.
100W into 4Ω, includes polyswitch speaker protector. Cat. KC-5019
Was $45.95
Now $29.95
Save $16.00

4 CHANNEL GUITAR MIXER AND PREAMP



See 96 Cat. page 9.
Cat. KC-5107
Was $49.95
Now $29.95
Save $20.00

DIGITAL VOLT METER FOR CARS

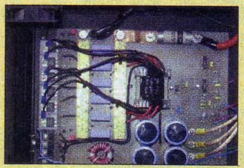


See 96 Cat. page 19.
Cat. KC-5134
Was $32.95
Now $19.95
Save $13.00

DIGITAL EFFECTS UNIT

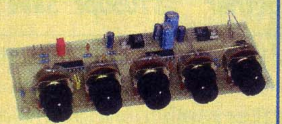
See 96 Cat. page 10. Cat. KC-5179
Was $169.00
Now $99.00
Save $70.00

600W DC -DC CONVERTER



See 97 Cat. page 6. Cat. KC-5212
Was $299
Now $229
Save $70.00

5 BAND EQUALISER

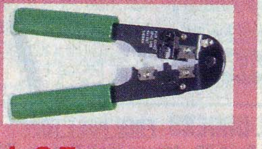


See 96 Cat. page 6.
Cat. KC-5197
Was $39.95
Now $24.95
Save $15.00

DOOR MINDER

See 96 Cat. page 22. Cat. KC-5188
Was $27.95
Now $14.95
Save $13.00

MODULAR TELEPHONE CRIMPING TOOLS

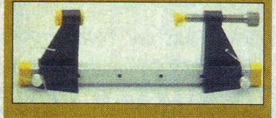


4P2C / 4P4C TOOL
Cat. TH-1930
Was $24.95
Now $14.95 Save $10.00

6P6C / 6P4C TOOL Cat. TH-1932
Was $27.95
Now $17.95 Save $10.00

8P / 8C TOOL Cat. TH-1934
Was $31.95
Now $21.95 Save $10.00

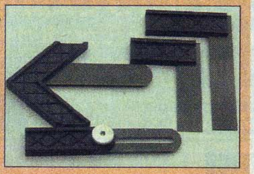
150MM SLIDING BAR



This is basically an adjustable G Clamp. The clamp slides up the bar which in turn varies the jaw opening immensely. Jaw opening up to 70mm. Bar is aluminium. Total length is 153mm.

Cat. TH-1958
Was $13.95 Save $7.00
Now $6.95

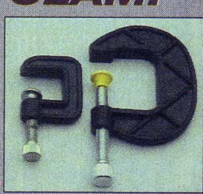
4 PIECE SQUARE SET



Consists of a 4" (100mm) & 3" (75mm) Set Square, 4" (100mm) Adjustable Bevel and a Centre Finder. All have steel straight edges with plastic handles. Made in New Zealand.

Cat. TH-1952
Was $22.95 Save $8
Now Only $14.95

G CLAMPS



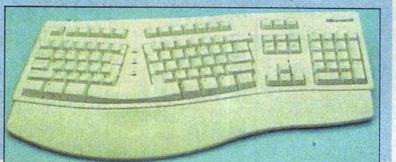
12MM G CLAMP

Plastic "G" with steel thread. Max opening 12mm. Cat.TH-1954
Was $5.95
Save $3.00
Now $2.95

24MM G CLAMP

For those slightly bigger jobs. Plastic "G" with steel thread. Max opening 24mm.
Cat. TH-1956 Was $7.50
Save $3.55 **Now $3.95**

MICROSOFT NATURAL KEYBOARD



This keyboard helps you work comfortably by naturally positioning and supporting your hands, wrists and forearms. 104 key layout.

Cat. XC-5090 **April $69**

INSIDE / OUTSIDE DIGITAL THERMOMETER WITH CLOCK AND DATE

Look at both temperatures at once. See 96 Cat.P 17.

Cat. XC-0125 Was $19.95

Apr. $15.00 Save $4.95

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PC - CONTROLLED ARBITRARY WAVEFORM / FUNCTION GENERATOR KIT

New '97

Ref: Electronics Aust Dec '96, Feb, March, April 1997

This project connects to your PC's parallel port to produce signals of virtually any desired waveform at frequencies below 0.25Hz to beyond 100kHz. The generator is software driven and will allow you to download waveforms from your PC and playback at the desired frequency. On-board RAM can store up to 32,768 bytes of waveform samples such as those produced by our Pocket Sampler Kit, KA-1787. Low cost software is available from the EA BBS or from the magazine direct (details supplied). The Jaycar kit is supplied complete with case, mains transformer, PCBs, professionally punched and silk screened front panel plus all specified electronic components, including a complete set of IC sockets for no extra cost.

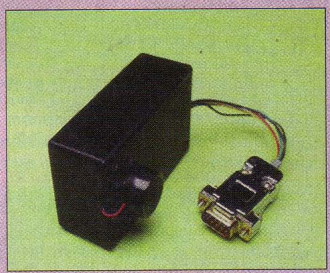
Cat. KA-1792 **$99.00**

AUDIBLE ALARM KIT FOR CRITICAL CAR SYSTEM

New '97

Ref: Electronics Australia March, 1997.

A dim warning light hidden in an obscure recess on the dashboard is pretty difficult to see on a bright sunny day. This simple and inexpensive kit could save you thousands of dollars in engine repairs by providing an 8-second audible warning if critical systems such as brakes, oil, etc are compromised. Whatever the system, this kit will put you back in charge over inadequate dashboard lamps - it even beeps if you turn your engine off when the headlights have been left on! Easy to build and hook up. Kit includes jiffy box, PCB, all electronic components plus free set of IC sockets.



Cat. KA-1791 **$16.95**

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New '97

Ref: Electronics Australia April 1997.

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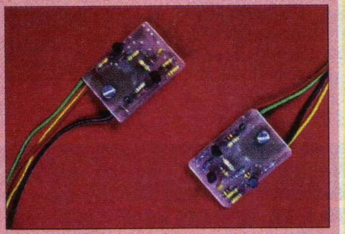

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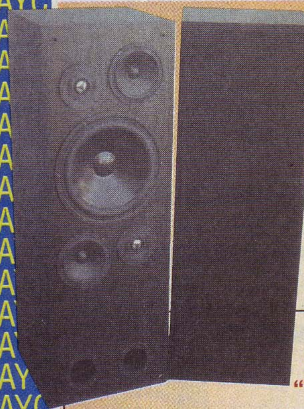
AUDIOHM AUDIBLE CONTINUITY TESTER KIT

New '97

Ref: Silicon Chip March, 1997.

Most continuity testers simply beep at you when the circuit being tested is good. The Audiohm Tester gives a tone which varies from a low frequency note of a few hundred hertz for low resistance to just above audibility for an open circuit. As well, it can test diode and transistor junctions and will even give a relative indication of the capacitance and leakage of electrolytic capacitors! The Jaycar kit includes case, PCB, silk screened front panel, quality Mylar loudspeaker and while stock lasts, a set of quality test probe leads absolutely free.

Cat. KC-5219 **$16.95**



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See 1996 Catalogue page 47 for full details.

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Quote from Leo Simpson - Silicon Chip on JV100's

"This speaker really performs, with prodigious power handling and beautiful bass down to below 30Hz. But as well as power handling and extended bass response, the system is very satisfying in its handling of all types of music with a smooth midrange and very clean treble reproduction."

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New '97

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Size: 220(H) x 225(W) x 677(D)mm.

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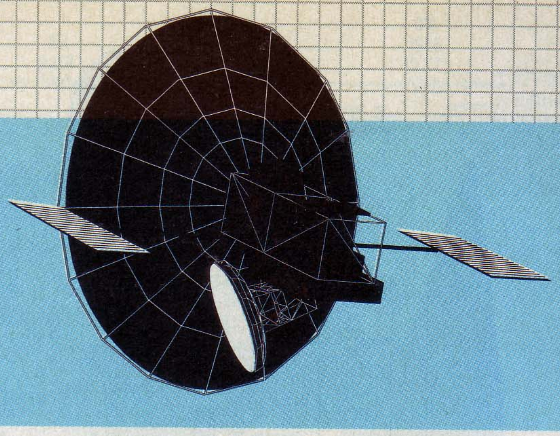
SATELLITE WATCH



Compiled by GARRY CRATT*

Magnetic storm claims Telstar 401

A violent magnetic storm on January 11th, believed to be caused by a coronal mass ejection (a magnetically charged cloud of hydrogen and helium) from the Sun on January 6th, is the most likely cause of the failure of Telstar 401. This was an AT&T television relay satellite located at 97° W, serving continental USA.

All control of the satellite was lost, although the spacecraft remains on station, with no observable signal emissions and no response to ground control.

Telstar 401 was one of two primary spacecraft in AT&T's Skynet network. The spacecraft was insured for about US$145 million. AT&T has applied to the FCC for permission to move Telstar 302, a 12-year old satellite used for telephone traffic into the 97° W slot.

In 1994, solar storms caused electrical failures in two Canadian Anik satellites, as well as Intelsat K. Two of the three spacecraft recovered while the third suffered a permanent power reduction.

JCSAT 5, 150° E longitude:

Japan Satellite Systems has announced a November launch for JCSAT 5, a Hughes HS-601 that will be located at 150° E. The satellite will be used to carry television, voice, data and internet services from Japan to the Pacific.

Present information indicates that the satellite will carry 32 K-band transponders only. The effect (if any) of this new satellite on the operation of Palapa C1, located at 150.5° E, remains to be seen.

JCSAT4, 124° E longitude:

JCSAT4 was successfully launched by an Atlas rocket on February 17th and will be located at 124° E. The satellite has 12 C-band transponders, 28 K-band transponders and has a footprint covering Japan, India, Australia and New Zealand.

Late December saw the disappearance of two Chinese analog signals on Asiasat2, HN TV and Quandong TV. Replacing these two services are nine digital services, including HN TV and GD TV, previously available as analog services. CCTV4, RTPI, TVSN and the Egyptian channel RTE remain in analog format. RTE commenced transmission on Asiasat 2 in mid December. It requires a 3m dish for good reception along the east coast of Australia and New Zealand.

Asia Satellite Telecommunications has filed a claim for US$58 million against the launch insurers of Asiasat 2 for the loss of nine K-band transponders. The loss has been attributed to excessive vibration during a "rough ride" on the Long March launch vehicle in November 1995.

Elsewhere, Laotian TV has appeared on Gorizont 30 (142.5° E) at an IF of 1375MHz, LHCP and at good signal strength across Australia. Curiously, rebroadcasts of Australian regional soccer matches have appeared on this channel, bearing the Optus Vision logo, as well as that of Laos TV channel 3.

This channel was previously located on the old Rimsat G1 satellite at 130° E. This brings the number of active transponders to three, as EMTV and Asia Music/Zee education continue to operate on this satellite.

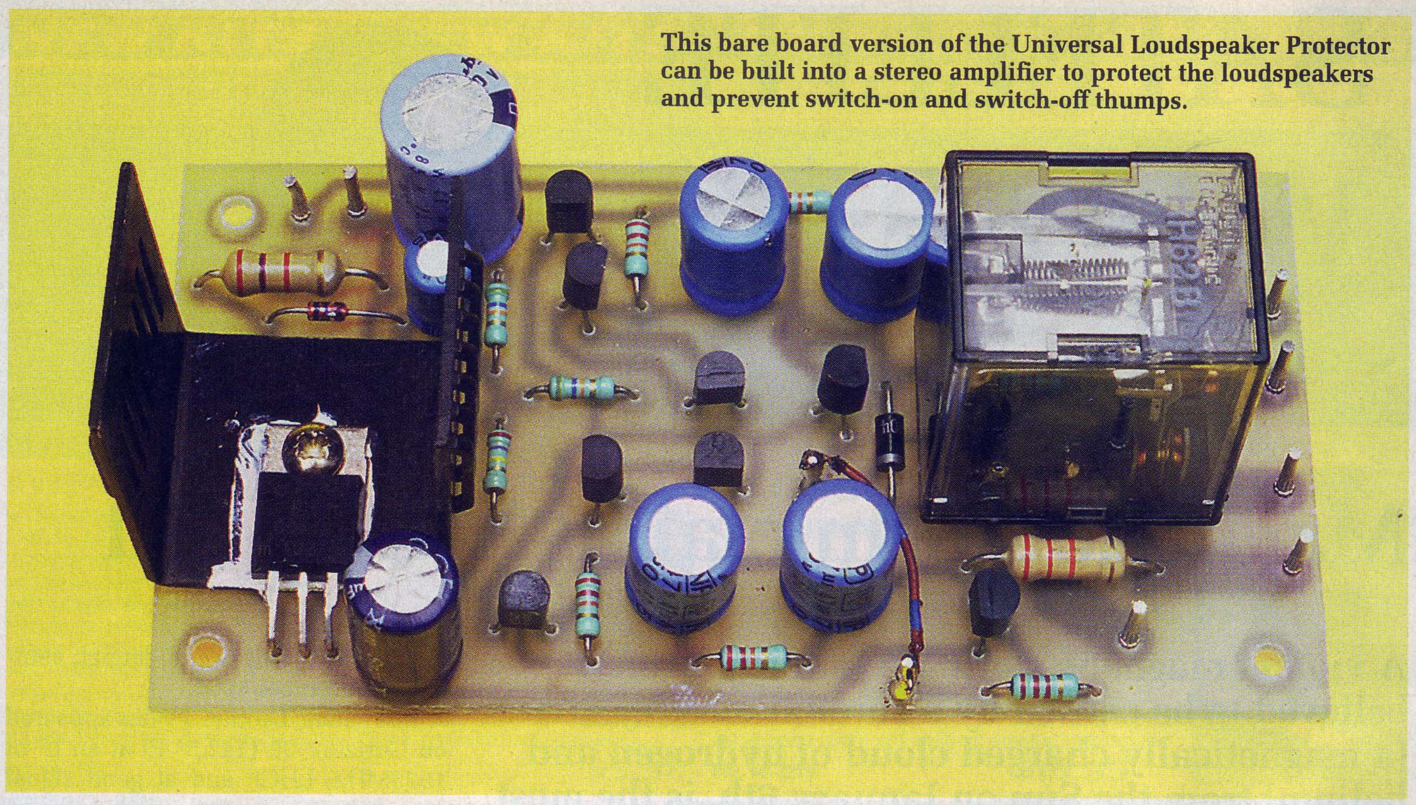
Optus B3, 156° E longitude:

Details of the new "Aurora" digital satellite platform utilising the Optus B3 satellite at 156° E were released by Optus at the Sydney Cable Show held in February. The platform would seem ideal for a satellite-based pay TV service, competing with Galaxy.

It is also probable that this platform will be used to carry ABC and SBS in digital format on a national beam, giving central and western Australians their first taste of SBS programming. Earliest projected operational start is given as September 1997.

For readers equipped with internet facilities, two new sites have appeared this month. Star TV can be found at http://www.startv.com while Asiasat is at http://www.asiasat.com.hk. **SC**

* Garry Cratt is Managing Director of Av-Comm Pty Ltd, suppliers of satellite TV reception systems. Phone (02) 9949 7417. http://www.avcomm.com.au



This bare board version of the Universal Loudspeaker Protector can be built into a stereo amplifier to protect the loudspeakers and prevent switch-on and switch-off thumps.

By LEO SIMPSON & BOB FLYNN

A universal loudspeaker protector for stereo amplifiers

This simple circuit is designed to mate with any stereo amplifier, music system or car sound system and will protect the loudspeakers from damage in the case of an amplifier failure. It could also prevent a fire. It has a turn-on delay and will eliminate switch-on thumps.

Do you leave your stereo amplifier or home music system permanently switched on in standby mode? Do you realise they could be a fire hazard? If you haven't thought about this problem in the past, then this article is for you.

Most power amplifiers these days are direct-coupled to the loudspeakers. This means that there is no output coupling capacitor in series with each loudspeaker terminal. This is true whether you have a large stereo amplifier which delivers several hundred watts per channel or a typical home music system which can be turned on and controlled by a remote control handpiece.

This means that if an output transistor goes short circuit or in the case of smaller home music systems, a hybrid power amplifier fails, virtually the full supply rail to that part of the circuit will be applied to the loudspeaker.

The result is usually a burnt out loudspeaker voice coil or damaged suspension system. That's expensive to fix but it may not be the end of the matter. In a worse case, the large DC current in the voice coil does not burn it out immediately but allows it to get red hot so that it sets the speaker cone on fire. From there, the acetate filling material in the enclosure and the grille fabric also catch fire, generating huge quantities of choking black smoke.

Ultimately, your house may catch fire too. This is not an imaginary scenario. Stereo systems do fail and they

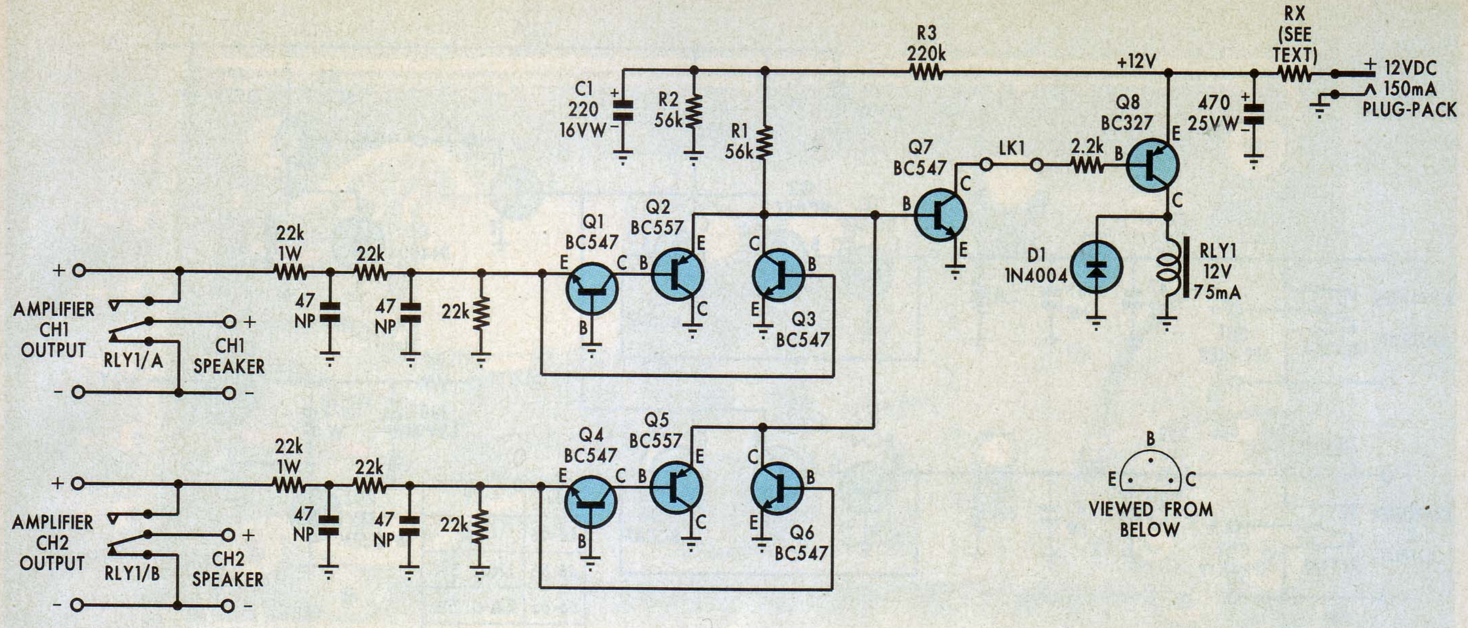


Fig.1: this is the self-contained version of the Universal Loudspeaker Protector, intended to be powered from a 9V or 12V DC plugpack. Q1, Q2 and Q3 monitor the output of channel 1 of the amplifier while Q4, Q5 & Q6 monitor the second channel. If a high DC offset is detected, the base current to Q7 will be shunted to deck and this will cause Q8 and the relay to turn off.

can cause house fires. That is why they should not be left on for long periods of time, especially if no-one is present to turn them off in the case of a fault.

Why does this sort of amplifier fault cause so much heat in the voice coil of a loudspeaker? Well, consider a 100W per channel amplifier with ±50V supply rails and driving loudspeakers with a voice coil resistance of 6Ω, a typical value for a speaker with a nominal impedance of 8Ω.

If one of the amplifier's output transistors fails, it will apply almost the full DC supply rail of 50V to the loudspeaker. The resulting heat dissipated by the voice coil will be $50V^2/6$ = 416W! No wonder the voice coil gets hot and burns out!

Actually, the power dissipation is generally not as high as that because the power supply voltage will drop under such a serious load. If you're lucky, the amplifier's fuses will also blow before a fire starts, limiting the damage to just the amplifier and the victim loudspeaker.

Fire insurance

Now the only safe way to prevent a major fault occurring while you're not listening to your music system is to turn it off at the wall socket. But faults can still occur while you are listening to the system and if you're not actually in the room at the time to turn it off when a major fault occurs, the results will be costly. So to prevent damage to your expensive speakers you need to build the Universal Loudspeaker Protector presented in this article.

The Universal Loudspeaker Protec-

Advantages Of This New Protector

This is not the first loudspeaker protector circuit we have published. The last one was featured in the July 1991 issue of SILICON CHIP. This new circuit was produced as a result of development work we have been doing on a high-power bridge amplifier. The new circuit is built onto a substantially smaller PC board and copes with an amplifier fault condition that would be ignored by the previous circuit.

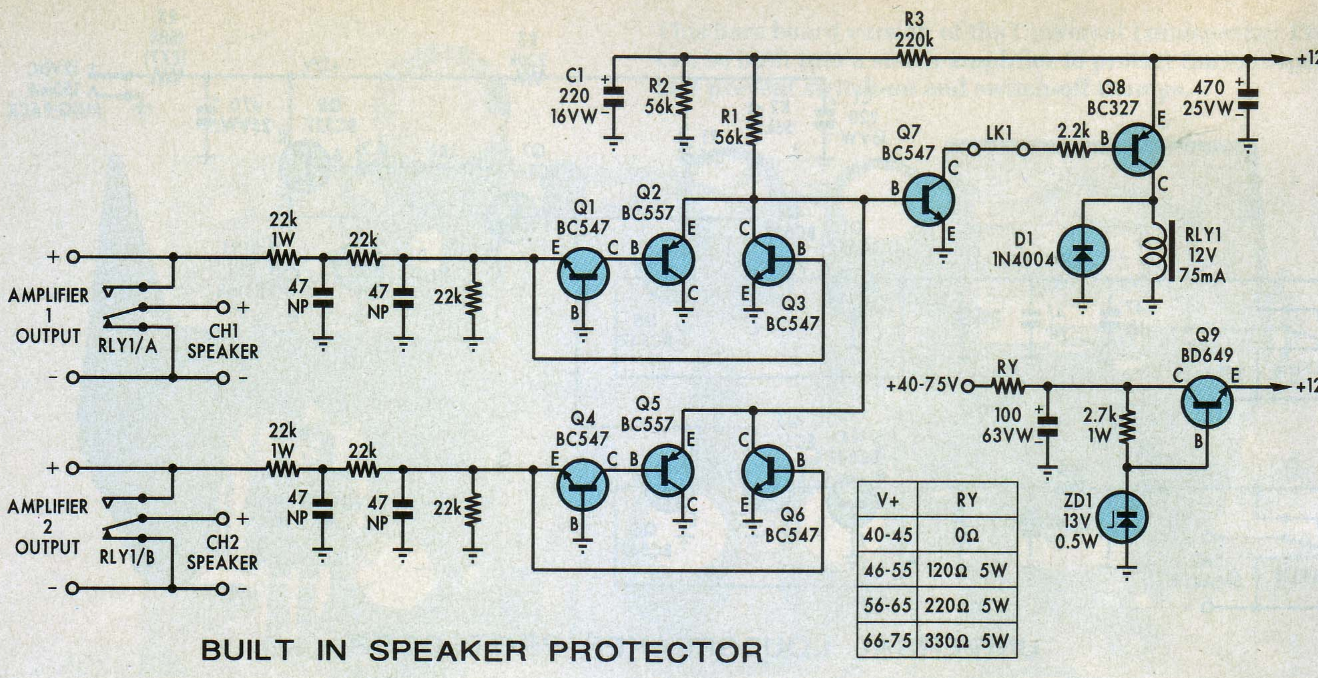
By using separate monitoring circuits for each channel of the amplifier, the ULP can respond to a DC fault condition in one or both channels of a stereo amplifier. The previous Loudspeaker Protector (published July 1991) had only one monitoring circuit which summed the active lines from the loudspeakers.

If the amplifier in question failed simultaneously in both channels, it is possible that one channel would produce a positive DC fault and the other channel a negative DC fault. If a common sensing circuit was used, these two fault conditions would effectively cancel each other out and the Loudspeaker Protector would fail to operate.

Is it possible for both channels of an amplifier to fail at once? And with opposite faults in both channels? Definitely!

It is certainly possible although we admit that it is unlikely with conventional stereo amplifiers. However, where a stereo amplifier is driving a single loudspeaker in bridge mode, it is highly likely.

In most bridged amplifiers, one channel gets its signal from the output of the second channel. So if the second channel fails and its output goes high, the first channel will have its output forced low. So the fault condition will exist in both channels and both channels must be sensed separately, as in the ULP.



V+	RY
40-45	0Ω
46-55	120Ω 5W
56-65	220Ω 5W
66-75	330Ω 5W

Fig.2: this version of the Universal Loudspeaker Protector is identical with that shown in Fig.1 except that it derives its power from the amplifier's DC supply via regulator transistor Q9.

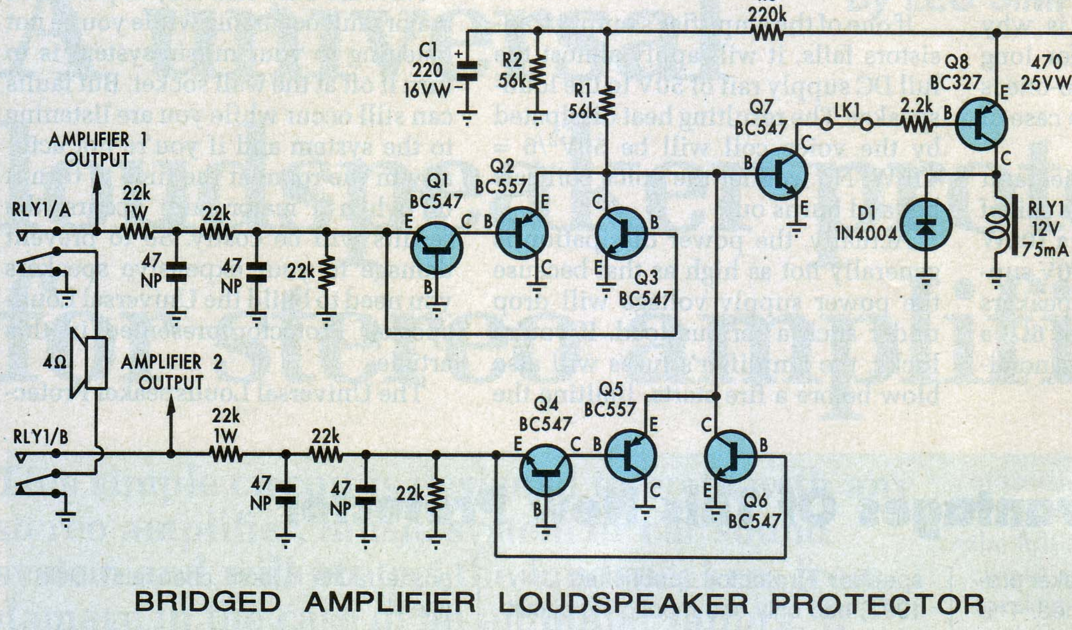


Fig.3: this version of the Universal Loudspeaker Protector is mainly intended for protecting speakers connected to bridged output amplifiers in cars.

tor (ULP) will continually monitor the DC conditions at the outputs of your stereo amplifier. If a fault occurs, the ULP will operate a relay to disconnect the loudspeakers.

As a bonus, the ULP has a delay at switch-on and if it is built into a stereo amplifier, it will prevent switch-on thumps from the loudspeakers.

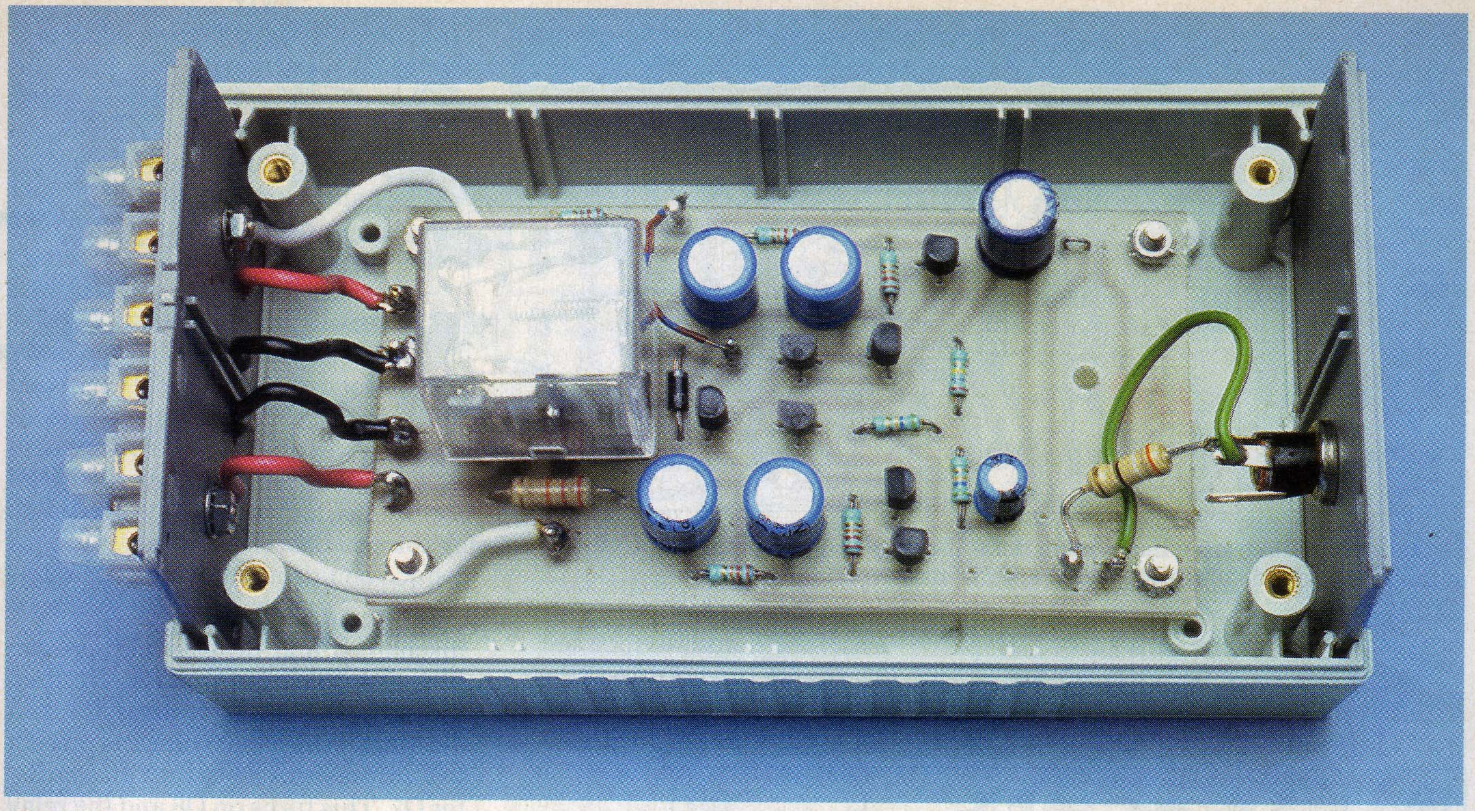
Three versions

We are describing three versions of the ULP. One is self-contained and powered with a 9V or 12V DC plug–pack. The second is intended to be built into a stereo amplifier and has its own on-board regulator. The third version is intended for bridged amplifiers in cars. We'll talk about these two latter versions later in this article.

Fig.1 shows the complete circuit diagram of the self-contained version. Let's talk about how Q1, Q2 & Q3 monitor the active output terminal of an amplifier. The active signal is fed via a two-stage low pass filter network consisting of three 22kΩ resistors and two 47µF NP (non-polarised) electrolytic capacitors. This filter network effectively removes any audio frequencies and ensures that only DC signals are fed to the following transistors.

This is necessary because we don't want normal audio signals to trip the ULP in any way.

Now let's see how the three transistors operate together. The line from the low pass filter is connected to the emitter of transistor Q1 and the base



The self-contained version of the Universal Loudspeaker Protector is housed in a plastic case and powered from a 9V or 12V DC plugpack. Note the resistor in series with the DC power socket. This is only required if a 12V DC plugpack is used (see text).

of transistor Q3. In effect, Q1 monitors for negative DC signals while Q3 monitors for positive DC signals.

If a positive DC signal of more than 0.6V is present, Q3 will turn on. Similarly, if a negative DC signal of more than 0.6V is present, the emitter of Q1 will be pulled below its base and so Q1 will turn on and turn on Q2. Both Q2 and Q3 have a common 56kΩ load resistor (R1) and this normally feeds base current to Q7. Q7 feeds base current to Q8 and so both of these transistors and the relay are on.

However, when either Q1 or Q3 turn on, the base current for Q7 is shunted to deck and so Q7, Q8 and the relay are turned off, disconnecting the speakers.

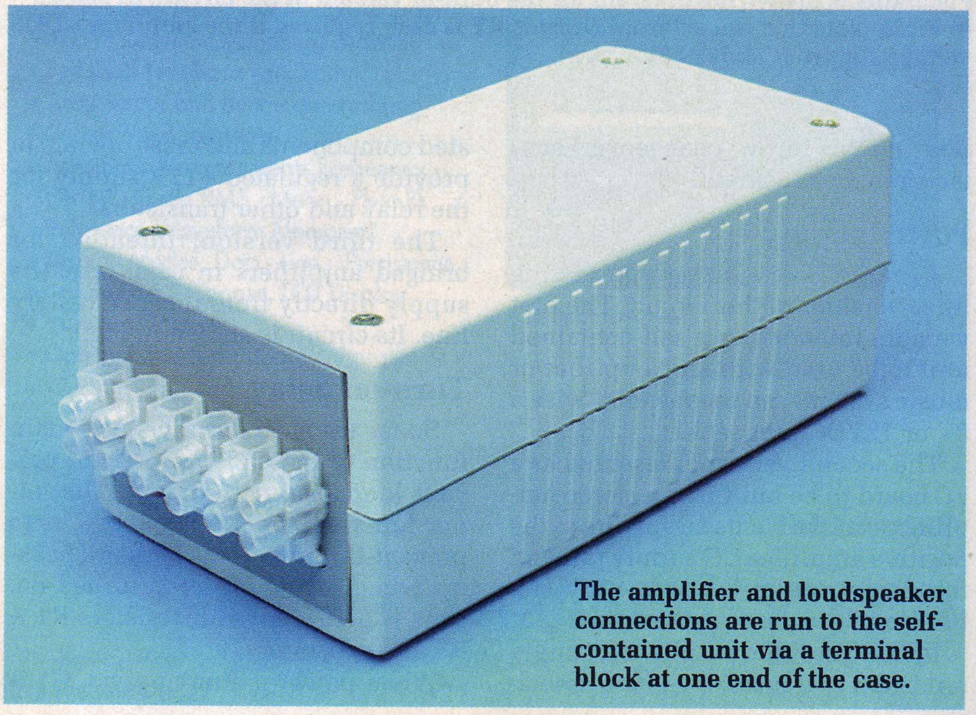
The same working principle applies to the monitoring of the second amplifier channel, with Q4 sensing negative DC signals and Q6 sensing positive DC signals. Q5 & Q6 share the same common 56kΩ load resistor as Q2 & Q3. So if either of these transistors are turned on by fault voltages, they will also rob Q7 of base current and cause Q8 and the relay to turn off.

Arc protection

When the relay operates to disconnect the loudspeakers, the moving contacts are shorted to the loudspeaker ground lines via the "unused" contacts. This has been done because if a large DC voltage (say more than 30V) appears at the amplifier outputs, the resulting high current can cause an arc across the relay contacts. Until that arc is extinguished, the loudspeaker is still being subjected to the high current and the possibility of damage.

By shorting the moving contacts of the relay to the speaker ground lines, the arc current is diverted and the amplifier fuses will blow if the arc still persists.

The fact that this Universal Loudspeaker Protector can be used with high power amplifiers which can produce very large output currents means that a heavy duty relay must be used. The one specified has DPDT (double



The amplifier and loudspeaker connections are run to the self-contained unit via a terminal block at one end of the case.

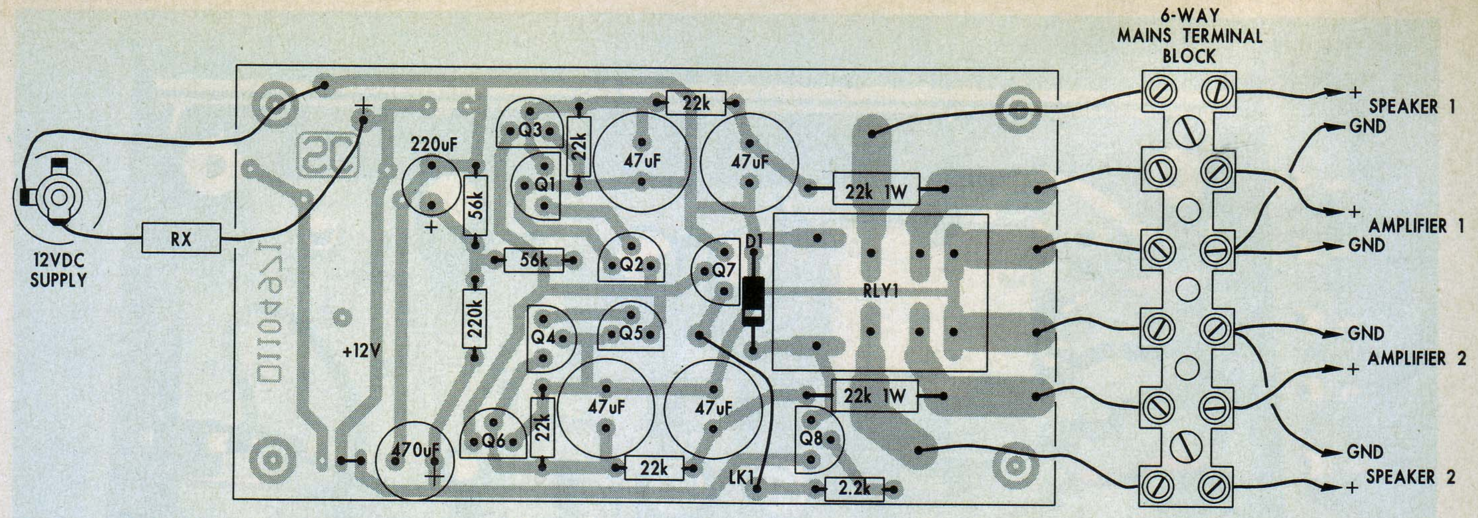


Fig.4: use this diagram when wiring the self-contained version of the ULP. The missing components at the lefthand side of the PC board are for other versions.

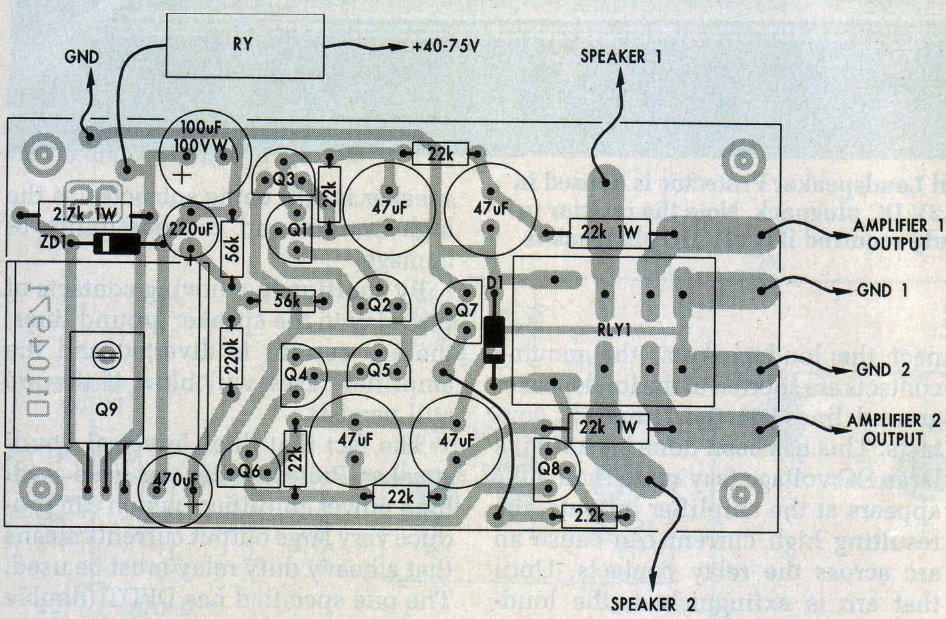


Fig.5: this is the wiring diagram for the built-in version of the circuit, as shown in Fig.2. Note that the external resistor RY is only required if the amplifier's DC voltage supply is above 40V.

pole, double throw; changeover) contacts rated at 10 amps.

Power supply

As noted above, we are presenting three versions of this circuit. The first version, intended as a self-contained unit to be used with any amplifier or music system, can be powered with a 9V or 12VDC plugpack.

The second version, presented as a PC board to be built into a stereo amplifier, can derive its supply from the positive amplifier DC supply rail and this can range from +30 to +75V DC. Its circuit diagram is shown in Fig.2.

In this case, the amplifier's supply rail is fed to transistor Q9 and associated components and these operate to provide a regulated +12V supply for the relay and other transistors.

The third version, intended for bridged amplifiers in cars, takes its supply directly from the 12V battery line. Its circuit is shown in Fig.3.

Turn-on delay

So far we have described the main function of the ULP which is to prevent loudspeaker burnouts. The minor function, mentioned above, is to prevent thumps from the loudspeakers when the amplifier is turned on. This is achieved with resistors R1 & R3 and capacitor C1.

When power is first applied, C1 is discharged and no base current can flow via 56kΩ resistor R1. C1 then charges via 220kΩ resistor R3 and eventually sufficient voltage is present to allow resistor R1 to turn on transistor Q7. This turns on Q8 and the relay and so the loudspeakers are connected to the amplifier. This delay is several seconds and it allows the voltages within the amplifier to stabilise, so when the speakers are connected, no thumps are heard.

When power is removed from the ULP circuit, the relay disconnects the speakers almost immediately, preventing turn-off thumps.

Note that this "thump" protection is only available if the ULP is powered from the supply rails of the amplifier, as in Figs.2 & 5. If it is built as a self-contained unit and powered from a DC plugpack, the thump protection will not be provided.

Construction

Let's now describe the construction of the self-contained version. All the parts are mounted on a PC board coded 01104971 and the wiring diagram is shown in Fig.4. As you can see, some parts are missing from one end of the board. These are for the on-board regulator (Q9, etc) which are used only in the in-amplifier version.

Fit the PC pins first and then the resistors. The four 47μF electrolytic capacitors can go in either way around since they are the non-polarised (NP) type. The 100μF capacitor is polarised and must be inserted the correct way around.

The eight transistors and the diode can be inserted next. Check that you

insert the correct type in each position and make sure that each is oriented exactly as shown in the wiring diagram.

Don't forget to install the wire link, LK1. This has been provided to enable a thermal cutout to operate the circuit but this feature is not used here.

Finally, the relay can be installed. We mounted ours by soldering short lengths of stout tinned copper wire to each relay pin. These wire leads are then pushed through the relay mounting holes on the board and then soldered. We understand that some kitset suppliers may provide a PC board with slotted holes so that the tinned copper wire may not be necessary.

With the board complete, it's time to install it in the plastic case. You may elect to use a different case from our prototype; as long as everything fits, the case size and shape are unimportant.

You will need to drill a hole at one end of the case to take the DC socket for the plugpack. At the other end you will need to mount a six-way insulated terminal block and drill holes for wires to run inside the case. Install the largest terminal block you can obtain which will fit. The larger ones have larger wiring holes which makes it easier to connect the speaker wires, particularly if you are using heavy-gauge cables.

Note that we have shown a resistor in series with the supply from the

PARTS LIST

Self-contained version
- 1 plastic case, 150 x 80 x 60mm
- 1 PC board, code 01104971, 107mm x 55mm
- 1 9V or 12VDC 150mA plugpack with 2.1mm DC plug
- 1 2.1mm DC socket
- 10 PC board pins
- 1 Relay DPDT 10A 240VAC, 12V coil @ 75mA, Jaycar SY-4065 or similar
- 6 3mm x 20mm screws
- 6 3mm nuts
- 4 6mm spacers
- 4 adhesive rubber feet

Semiconductors
- 5 BC547 NPN (Q1,Q3,Q4,Q6)
- 2 BC557 PNP transistors (Q2,Q5)
- 1 BC327 PNP transistor (Q8)
- 1 1N4004 silicon diode (D1)

Capacitors
- 1 470μF 16VW electrolytic
- 1 100μF 16VW electrolytic
- 4 47μF 50VW NP electrolytic

Resistors (1%, 0,25W)

1 220kΩ	2 22kΩ 1W
2 56kΩ	1 2.2kΩ
4 22kΩ	1 39Ω 0.5W (RX)

Extra parts for built-in version
- 1 BD649 NPN transistor (Q9)
- 1 13V 0.5W or 1W zener diode (ZD1)
- 1 100μF/100VW electrolytic capacitor
- 1 2.7kΩ 1W resistor
- 1 220Ω 5W wirewound (RY; see text)
- 1 U-shaped TO-220 heatsink (Altronics Cat H-0502 or equiv).

Value for Money 60MHz & 100MHz Scopes

Tektronix' new TDS-200 Series scopes are affordable, compact, general purpose digital storage scopes that offer more additional facilities than any analog scope.

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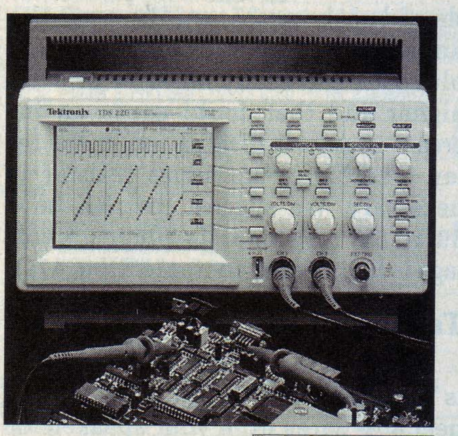
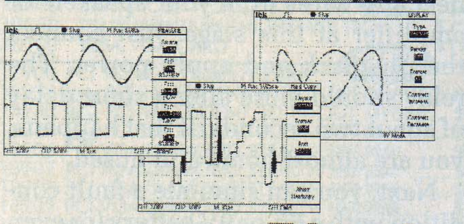
TDS210 $1,395 ex-tax $1,702 incl. Tax





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Bridged Amplifiers In Car Audio Systems

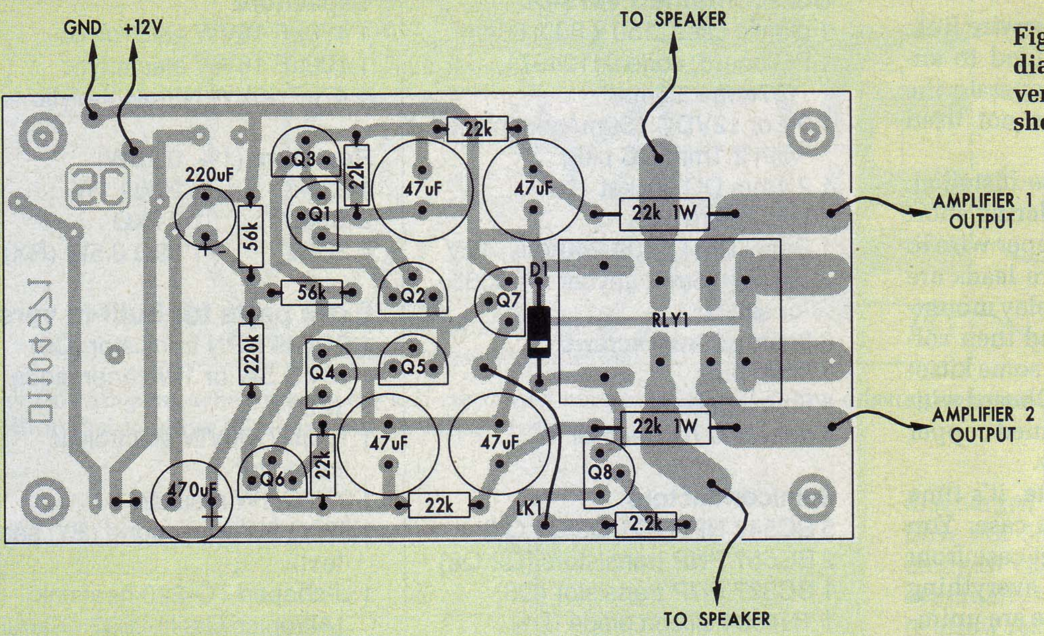

Fig.6: this is the wiring diagram for the bridged version of the ULP, as shown in Fig.3.

MANY HIGH-POWERED amplifiers in cars operate in bridged mode and they are often run at high power for extended periods. When they fail, the speakers are just as likely to be damaged as the speakers in a home stereo system. And the possibility of a fire is just as high. So to protect valuable loudspeakers in cars, the ULP is a wise investment.

You will need one ULP for each stereo amplifier and one for each bridged amplifier. In each case, the ULP can be powered directly from the +12V battery line.

The circuit for this bridged amplifier version is shown in Fig.3 while the wiring diagram is shown in Fig.6.

plugpack. It is marked RX on Fig.4. If you use a 9V plugpack, this resistor should not be necessary. However, the unloaded voltage of a typical 12V DC plugpack can easily be +15V or even higher and that could cause an increase in power dissipation in the relay. Therefore, the series resistor is necessary. We suggest that RX be a 39Ω 0.5W resistor. If the plugpack voltage is higher still, increase RX to 47Ω.

Testing

When all the wiring is complete, it is time for a power test. Do not connect any wires from your speakers or amplifier at this stage. Just connect the plugpack and apply power. The relay should close after a short delay of about two seconds. If that happens, you are almost home and hosed.

Next, you can simulate a fault condition with a 6V or 9V battery (or even two 1.5V cells in series). Connect the battery across each of the inputs in turn, first with one polarity and then the other. In each case, the relay should immediately open and then close as soon as the battery is removed.

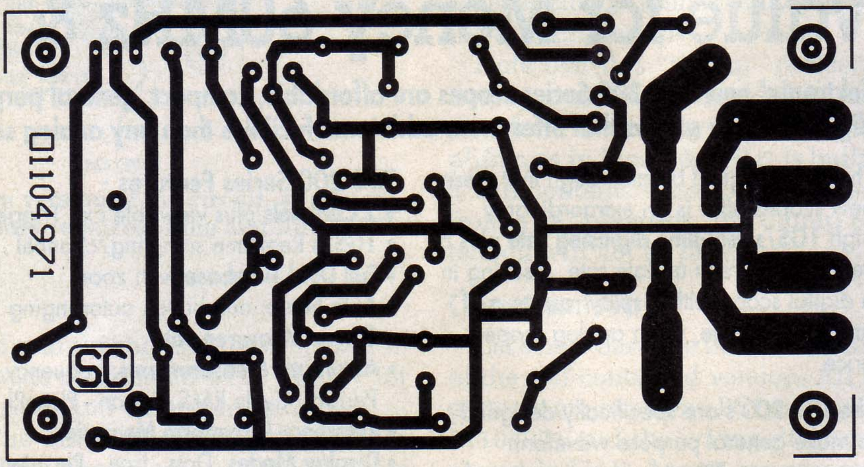

Fig.7: here is the full size etching pattern for the PC board.

If you strike trouble, switch off and check the circuit for errors. Normally, you can expect the unit to work as soon as you switch it on so now it should be merely a matter of wiring the unit in series with your loudspeakers and then you can rest easy.

Fig.5 shows the wiring of the built-in version. This is the same as for Fig.4 except that the regulator components involving transistor Q9 are included. Note that Q9 is mounted on a U-shaped heatsink.

In addition, if the amplifier's DC supply is above 40V, it will be necessary to connect an external 5W wirewound resistor (RY) in series with the collector of Q9. This resistor is shown on Fig.5 and a table of values is shown on Fig.2. For example, if the amplifier's DC supply is around 60V, resistor RY should be 220Ω 5W. **SC**

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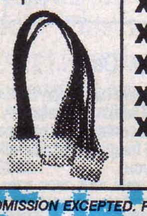

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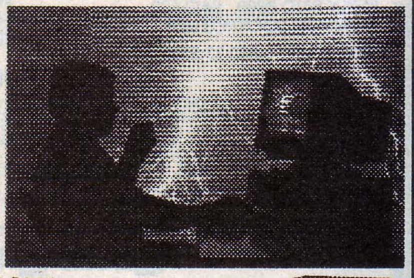

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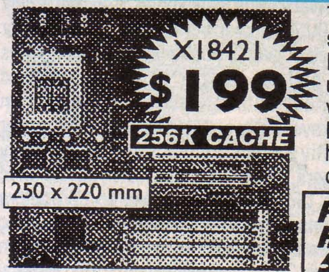

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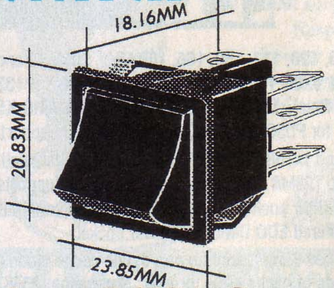

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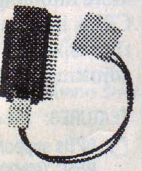

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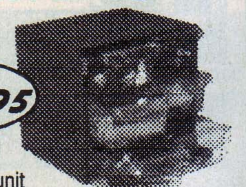

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Train controller for model railway layouts

This easy-to-build Train Controller will give full, realistic control of your model trains. One control provides full reverse to full forward speed. The circuit provides inertia and a brake switch and has automatic overload protection.

By RICK WALTERS

The big virtue of this new Train Controller is its single knob control. The one throttle knob gives full reverse speed when it is fully anticlockwise and full forward speed when it is fully clockwise. And when the knob is centred, the train is stopped.

This simple throttle control does away with the need for a forward/reverse switch or a relay and thus reduces the possibility of derailments which can damage expensive model rolling stock. This is especially the case if derailed rolling stock falls to the floor!

What is the problem with a forward/reverse switch or relay? Surely they are simple enough and are reliable? Well, yes they are but it is amazing how many people driving model trains operate the forward/reverse switch by mistake; it is quite easily done. And if the train is going at a fair pace, throwing it into reverse often just derails everything, which doesn't do a lot for realistic operation (to say nothing of the possibility of damage).

With this new Train Controller though, if you have the train going forward and decide to throw it into reverse by rotating the throttle knob quickly to full anticlockwise, there is no drama. The train slows down smoothly by virtue of the built-in inertia, comes to a stop and then accelerates equally smoothly in the other direction.

Oh, and there is another virtue in not having a forward/reverse switch. For one reason or another, many peo-

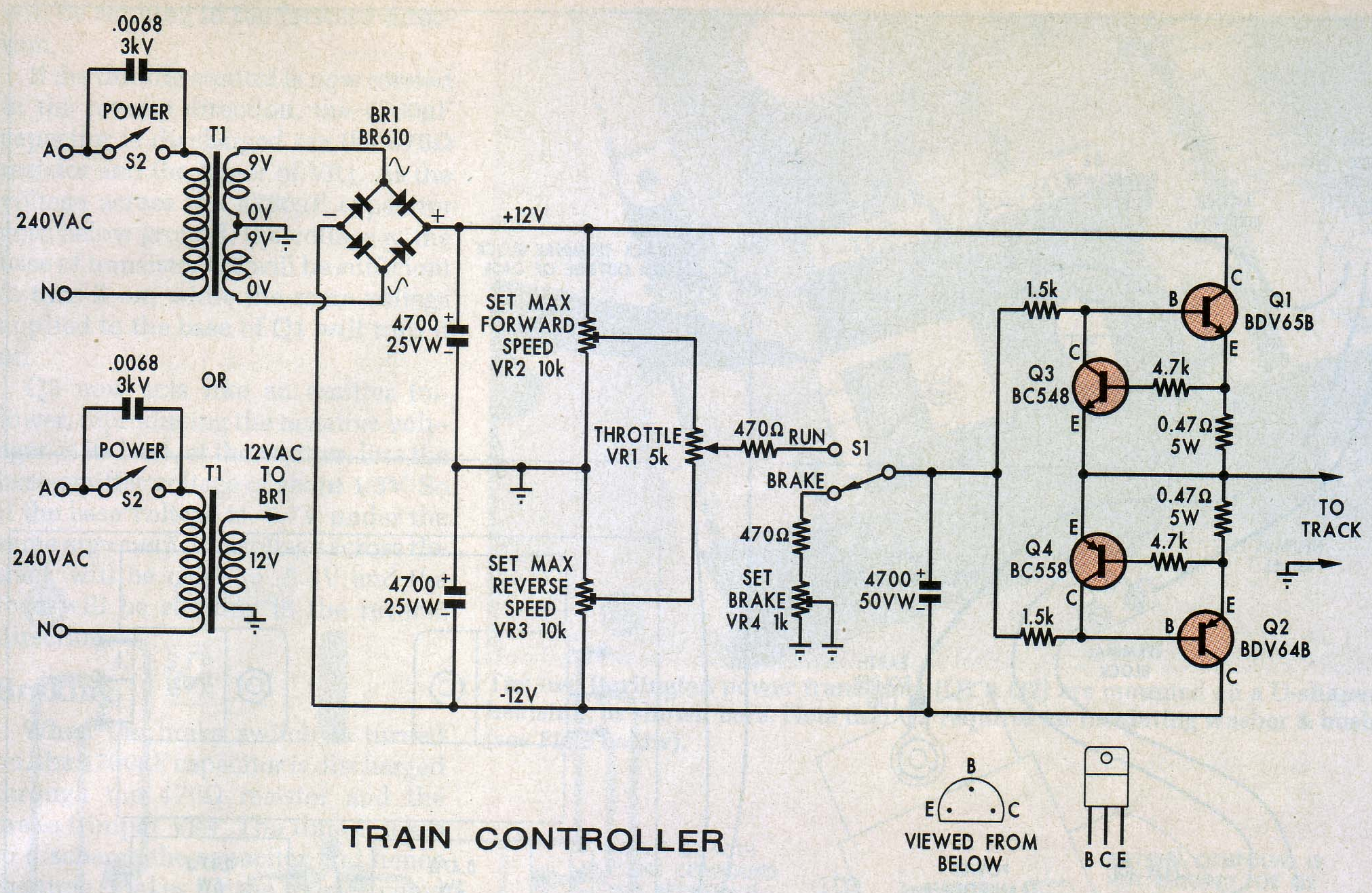


Fig.1: the circuit is essentially a combination of two complementary emitter followers controlled by the throttle potentiometer VR1. Overload protection is provided by Q3 and Q4. These monitor the track current through the two 0.47Ω resistors. The complementary design does away with the need to include a forward/reverse switch.

ple have trouble wiring them up correctly!

Other features of the controller are preset trimpots for maximum forward and maximum reverse speed and a trimpot for adjusting the degree of braking; you can have it really swift or more leisurely.

Actually, if the brake is applied to stop the train without rotating the control knob to the centre position, the train will stop as you would expect it to. But if the brake is then switched off, the train will gradually pull away and accelerate until it reaches the previous speed set on the control knob.

Finally, although this is an "unseen" feature, the Train Controller has automatic overload protection. So if a loco derails or someone inadvertently (or deliberately) shorts out the track, the Train Controller will take care of the overload and once the short is removed, normal operation will be instantly restored.

We've built our prototype into a plastic case, as shown in the photos but we assume that many modelling enthusiasts will build the controller underneath their layout and will make their own control panel.

Circuit operation

The complete circuit of the Train Controller is shown in Fig.1. It is virtually two speed control circuits in one. For forward speed operation, transistor Q1 feeds voltage to the track while for the reverse operation, transistor Q2 does the work. It is this scheme which allows us to do away with the forward/reverse switch.

This controller works by feeding pure DC to the track. It does not use pulsed DC or unsmoothed DC. While these other forms can give more reliable loco operation when the track or the loco wheels are dirty, pure DC results in the quietest operation of the loco motor. For some modellers this is a most important point.

A transformer with a centre-tapped 18V winding (ie, 9V a side) feeds a bridge rectifier (BR1) and two 4700μF 25VW capacitors to provide balanced supply rails of ±12V (nominal). As shown, the +12V rail feeds the collector of NPN Darlington power transistor Q1, while the -12V rail feeds the collector of PNP Darlington power transistor Q2.

Trimpot VR2 is connected across the +12V rail to provide the maximum forward speed setting while VR3 is connected across the -12V rail. The wipers of these two trimpots then feed each end of the throttle potentiometer, VR1.

Now let us see what happens when the throttle knob is rotated clockwise from its centre setting. Let's also consider that switch S1 is set to the "Run" position. As we rotate the throttle control clockwise, the voltage picked off by the wiper will rise accordingly and it will charge the 4700μF capacitor via the 470Ω series resistor.

After a short delay, caused by the charging of the 4700μF capacitor, the voltage at the base of transistor Q1 will be high enough to turn it on. From there on, as Q1's base voltage rises, it will act like an emitter follower, reproducing the voltage fed to its base at the emitter, less the base-emitter voltage of about 1.3V.

So if the base voltage to Q1 is +6.7V for argument's sake, the voltage across the track will be close to +5.4V. If a loco is connected across the track, it

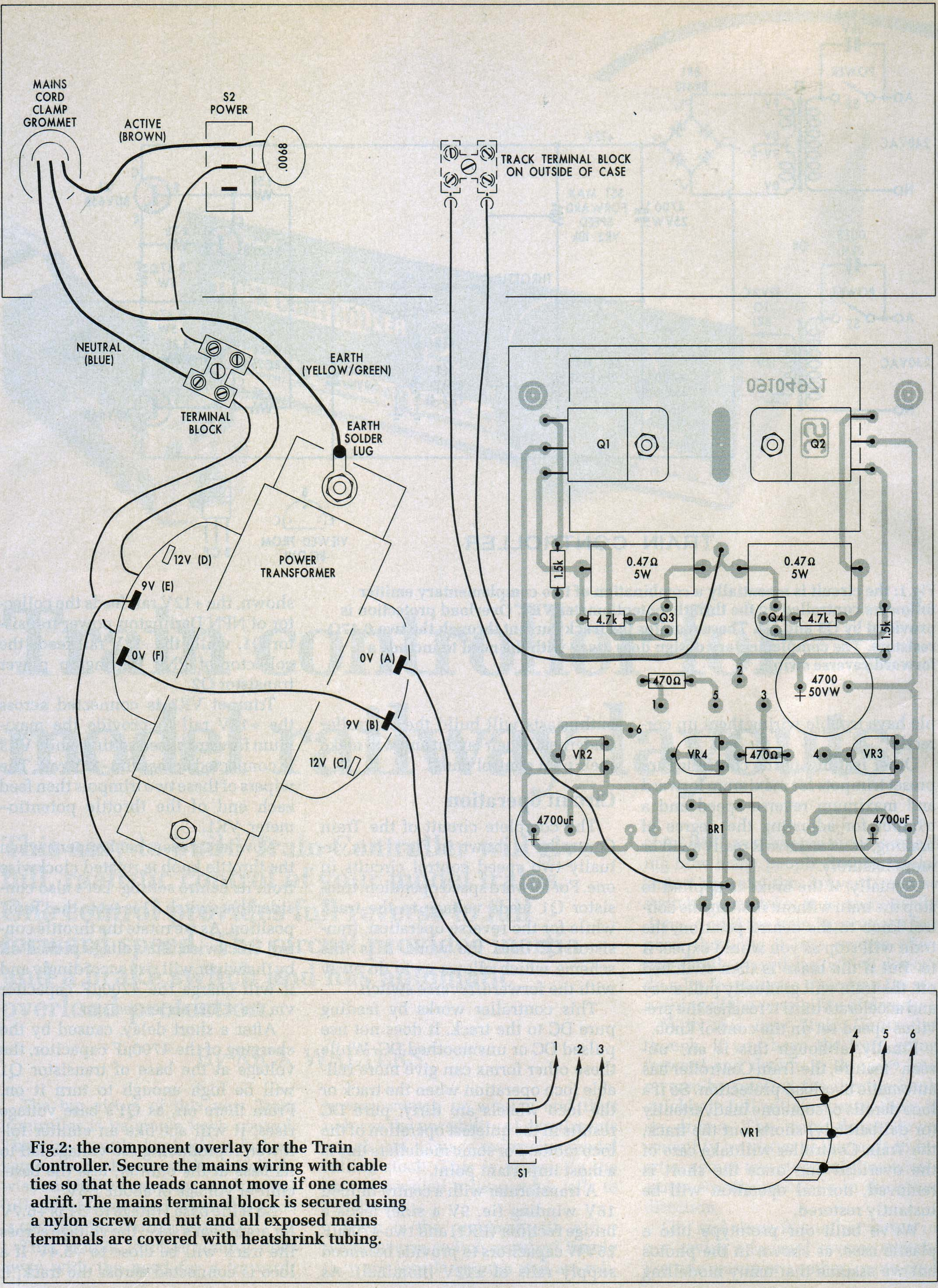


Fig.2: the component overlay for the Train Controller. Secure the mains wiring with cable ties so that the leads cannot move if one comes adrift. The mains terminal block is secured using a nylon screw and nut and all exposed mains terminals are covered with heatshrink tubing.

will be running in the forward direction.

If the throttle control is now rotated in the reverse direction, the 4700µF capacitor is discharged via the 470Ω resistor and the wiper of VR1. As the voltage across the 4700µF capacitor goes below ground, the voltage at the base of transistor Q2 will be sufficient to turn it on, while the same voltage applied to the base of Q1 will turn it off.

Q2 now acts like an emitter follower, reproducing the negative voltages at its base, at the emitter, less the base-emitter voltage of about 1.3V. So if the base voltage is -6.7V under the same argument, the voltage across the track will be close to -5.4V and the loco will be running in the reverse direction.

Braking

When the brake switch is turned on, the 4700µF capacitor is discharged through the 470Ω resistor and the brake trimpot VR4. The time it takes to discharge the capacitor and hence the time it takes for the train to come to a stop is determined by the setting of VR4. When the brake is switched off, the 4700µF capacitor will slowly charge up again to the voltage on the wiper of VR1 and the train will eventually resume the speed set before the brake was applied.

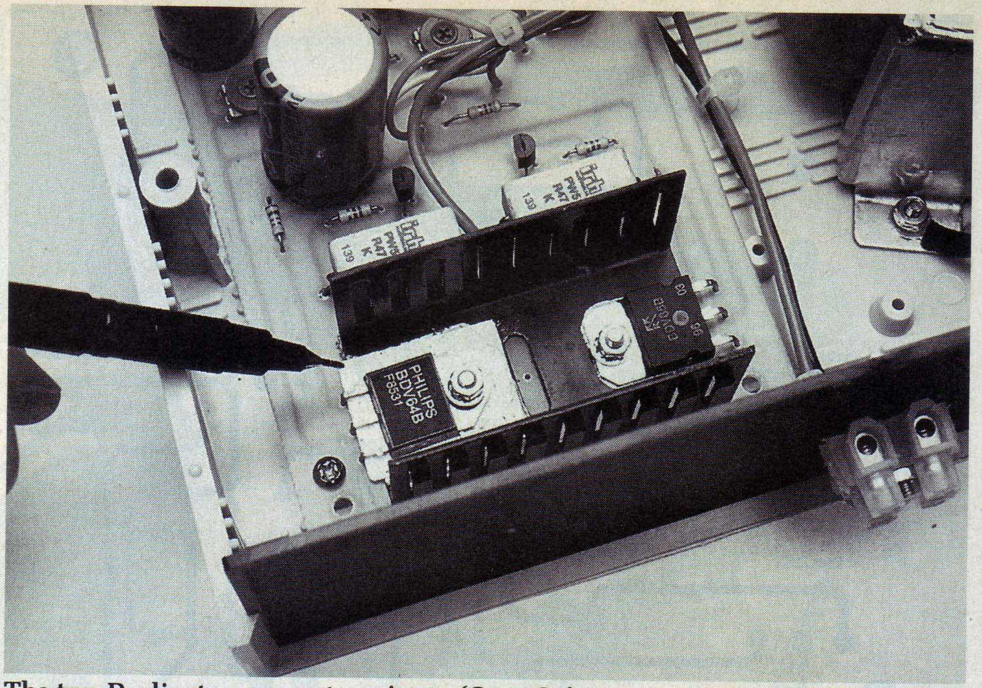
Short circuit protection

One of the features of the circuit is short circuit protection and this is provided by transistors Q3 and Q4. Q3 monitors the current through the 0.47Ω emitter resistor associated with Q1. If the emitter current of Q1 rises above about 1.3A, the resulting voltage across the 0.47Ω resistor will be sufficient to bias Q3 on. This will cause Q3 to shunt base current away from Q1, throttling it back.

If the emitter current tends to rise further, Q3 will turn on harder, shunting even more base current away from Q1 and throttling it back further.

A similar process applies to Q2 and Q4. Q4 monitors the emitter current of Q2 via the associated 0.47Ω resistor.

We have not included a warning device to indicate an overload as it should obvious when the train has stalled that something is wrong. Don't ignore the short as the conducting transistor will get very hot and the heatsink temperature will rise rapidly. In other words, the protection feature is really only intended to cope with short term overloads.



The two Darlington power transistors (Q1 & Q2) are mounted on a U-shaped heatsink, as shown here. Note that Q2 requires an insulating washer & bush (see Fig.3 below).

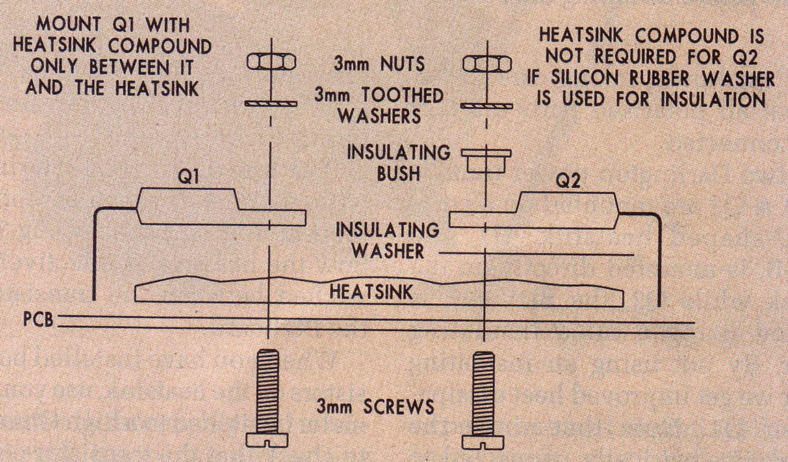


Fig.3: details of the heatsink mounting for Q1 & Q2. Note that Q2 must be electrically isolated from the heatsink.

Power supply options

The circuit of Fig.1 shows that two possible power transformer connections can be used. The first option is for a centre-tapped transformer, as described above. The second option is to use a single-winding 12V transformer. Whichever transformer is used, the circuit is unchanged. When the single winding transformer is used, the bridge rectifier acts like separate positive and negative halfwave rectifiers to develop positive and negative DC rails.

We'll talk more about these options later.

Building the controller

The Train Controller is housed in a plastic case measuring 203 x 68 x 158mm. The components are mounted on a PC board measuring 89 x 120mm and coded 06104971.

Fig.2 shows the wiring details for the Train Controller. Begin construction by carefully checking the PC board for shorted tracks or breaks. Repair any defects before proceeding further.

Mount the parts on the PC board

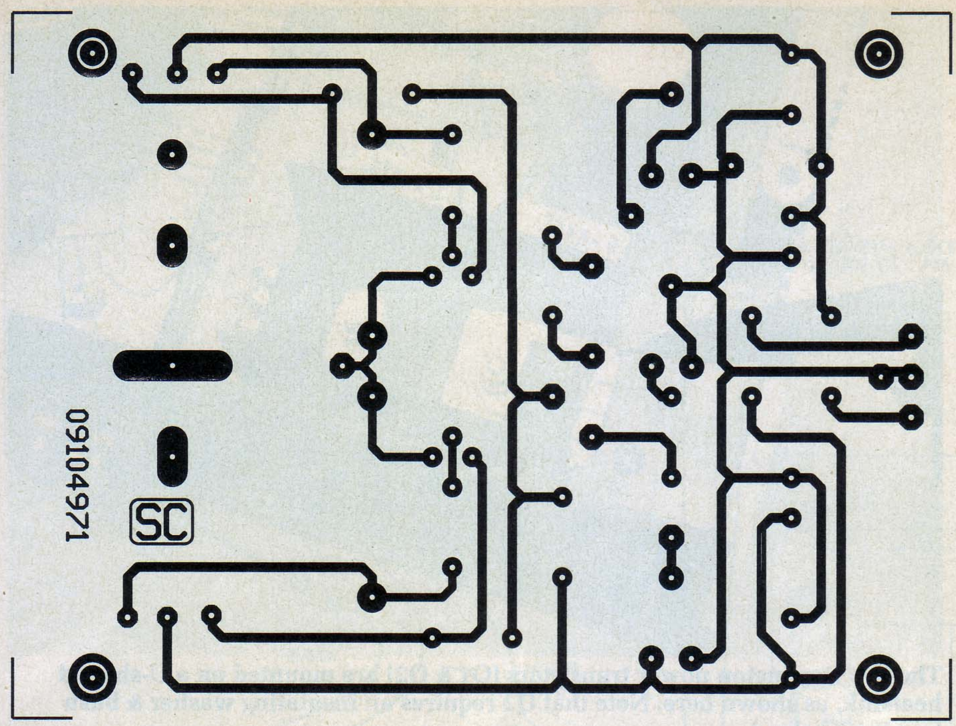


Fig.4: this is the full-size etching pattern for the PC board. Check your board carefully for etching defects by comparing it with this pattern and fix any problems before installing the parts.

exactly as shown, taking care to ensure that all polarised parts are correctly connected.

The two Darlington power transistors Q1 & Q2 are mounted on a common U-shaped heatsink. Q1, the BDV65B, is mounted directly on the heatsink while Q2, the BDV64B, is mounted using a mica insulating washer. By not using an insulating washer we get improved heat dissipation for Q1. Note that since the heatsink is electrically connected to the collector of Q1, it will be "live" at +12V or whatever is the value of the positive supply rail.

Both transistors should be installed with thermal compound applied to their mounting surfaces. Fig.3 shows how the heatsink is effectively sandwiched between the transistors and the PC board.

When you have installed both transistors on the heatsink, use your multimeter (switched to a high Ohms range) to check that the transistor collectors are isolated from each other.

You can solder all the external connections directly to the PC board or you can connect to solder stakes if you prefer. Use different coloured hook-up wire for the various off-board connections. It makes it a lot easier to troubleshoot the unit if it does not work when you first fire it up.

The transformer is screwed directly to the base of the case and one mounting foot is earthed back to the Earth wire of the mains power cord.

As discussed previously, you have two options for the power transformer. If you only have a small layout and will be using one loco at a time, a transformer with a single 9V to 15V 1A secondary winding can be used but if you intend to have a larger layout, it is worthwhile going for the larger centre-tapped transformer.

You could also use a ±12V DC power supply to feed the controller. If you do this you can fit 470µF capacitors instead of the more expensive 4700µF units specified. The PC board overlay allows for both sizes of capacitor.

Note that whichever supply option is used, the inertia capacitor must be 4700µF.

The front panel has only the main throttle control and brake switch mounted on it. Hence you will only need to drill two holes for these components before they can be wired.

On the back panel, you will need to drill holes for the two-way insulated terminal block for the output leads, the mains switch and the cordgrip grommet for the power cord. We used

PARTS LIST

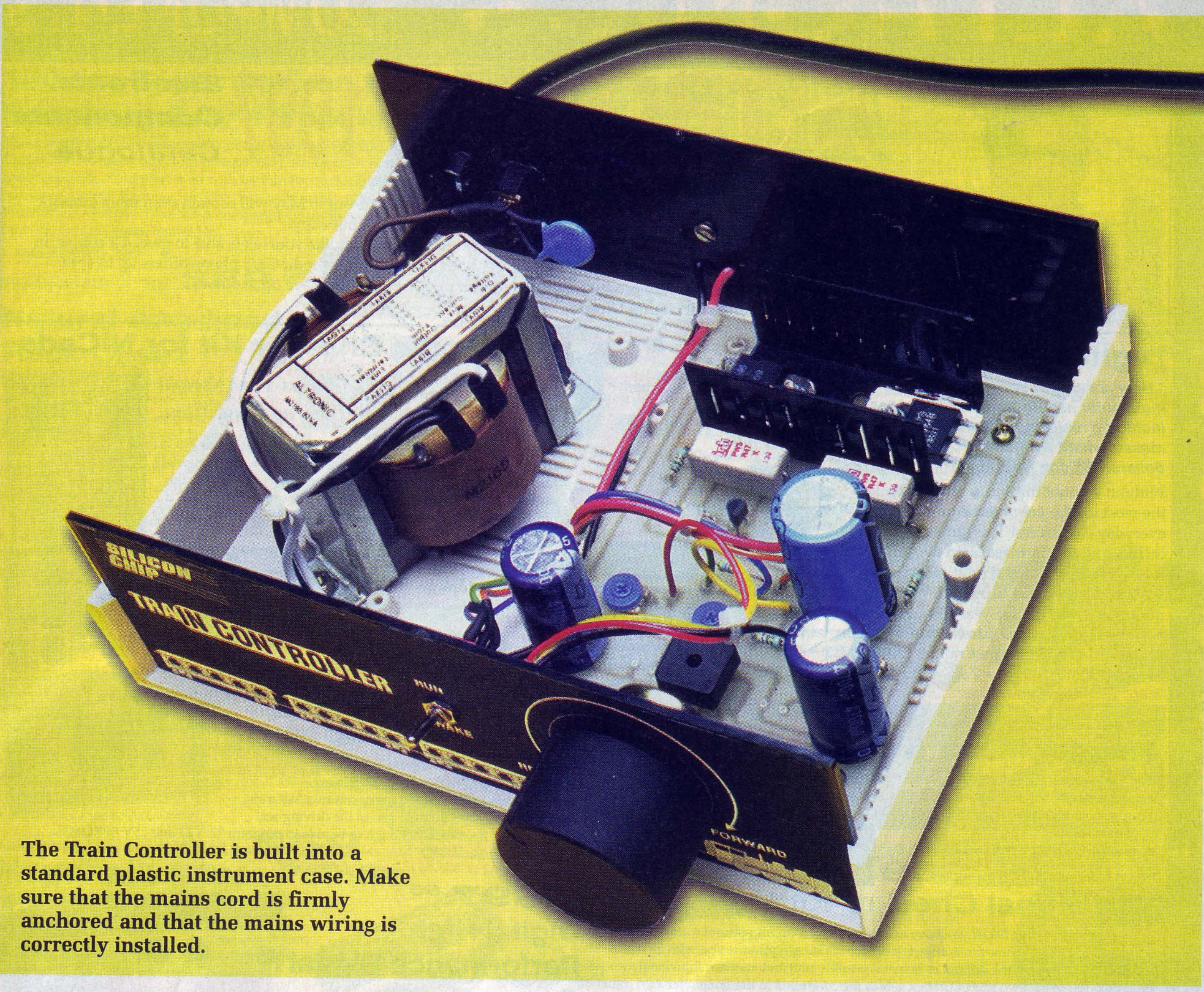
- 1 PC board, code 09104971, 120 x 89mm
- 1 mains transformer 18V CT 60VA, Altronics M-2165 or equivalent
- 1 plastic case, 203 x 68 x 158mm
- 1 3-core mains flex with 3-pin plug
- 1 cordgrip grommet to suit mains flex
- 1 SPDT switch (S1)
- 1 240VAC SPST snap-fitting rocker switch (S2)
- 1 large knob to suit VR1
- 1 U-shaped heatsink, DSE type H-3401 or equivalent
- 1 BDV64B mounting kit
- 2 2-way mains terminal blocks
- 1 3mm x 10mm nylon screw & nut (to secure mains terminal block)
- 4 6PK x 6mm screws
- 3 3mm x 10mm bolts
- 3 3mm nuts
- 3 3mm shakeproof washers

Semiconductors
- 1 BDV65B NPN Darlington transistor (Q1)
- 1 BDV64B PNP Darlington transistor (Q2)
- 1 BC548 or BC338 NPN transistor (Q3)
- 1 BC558 or BC328 PNP transistor (Q4)
- 1 6A bridge rectifier (BR1)

Capacitors
- 1 4700µF 50WV PC electrolytic
- 2 4700µF 25WV PC electrolytic
- 1 .0068µF 3kV ceramic

Resistors (0.25W, 1%)
- 2 4.7kΩ
- 2 470Ω
- 2 1.5kΩ
- 2 0.47Ω 5W wirewound

Potentiometers
- 2 10kΩ trimpots (VR2,VR3)
- 1 5kΩ linear potentiometer (VR1)
- 1 1kΩ trimpot (VR4)



The Train Controller is built into a standard plastic instrument case. Make sure that the mains cord is firmly anchored and that the mains wiring is correctly installed.

a snap fitting power switch which requires a rectangular cutout. This can be easily made in the plastic panel by drilling a suitable hole and then filing it out to the desired size.

The 3-core mains flex is passed through the cordgrip grommet which anchors it. The Active wire is terminated directly to one side of the mains on/off switch (S2) while the Neutral wire is terminated to a 2-way terminal block. The Active wire from the other side of the mains switch is also terminated at the terminal block. This block, which is secured using a nylon bolt, also terminates the primary wires from the transformer.

Note that the .0068μF 3kV suppression capacitor is wired directly across the mains switch S2. All connections to this switch should be fitted with heatshrink sleeving to prevent any chance of accidental contact.

When all the wiring is complete, go over your work thoroughly and cross-check it with the circuit and wiring diagrams of Figs.1 & 2.

Testing

Apply power and check the positive and negative supply rails. They should be roughly the same (absolute value) and will typically be about ±15V for a nominal 18V centre-tapped transformer, with no load connected to the output. This will drop when loaded.

Now rotate VR1 fully clockwise and check that the output voltage gradually rises towards the positive supply rail. We would expect a maximum value of about +13V, again with no load. You can tweak this value to whatever value you finally decide upon by adjusting trimpot VR2.

Similarly, rotate VR1 fully anticlockwise and check that the output voltage builds gradually to the value of the negative supply rail. We would expect a value of around -13V, with no load. Again, you can set the maximum negative value by adjusting trimpot VR3.

There will be some interaction between these two trimpots but a couple of tweaks should get them just right. VR4 can be set at any time to give a realistic braking distance.

With these checks done, it is time to run a train. Connect the Train Control to your layout (or a loop of track) and confirm that you can control a locomotive smoothly. When VR1 is at its centre setting, the loco should slowly come to a stop.

If you want to remove the inertia feature you can omit the 4700μF electrolytic capacitor connected to S1. Alternatively, if you want to reduce the inertia effect then make the capacitor smaller (1000-2200μF). The engine will now come up to speed quicker and brake quicker. **SC**

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ALTRONICS

ALTRONICS 1997 Electronic Components Catalogue

Watch Out for the Release of Our New 1997 Catalogue

We are proud to announce the **Altronics 1997 Engineering Catalogue,** due out in May will contain even more fantastic products and greater value for money than ever before. So be sure to get your copy.

We still offer the technical assistance that only a staff of electronic enthusiasts like yourself is able to give. Of course, in addition to this we have our Famous Overnight Australia Wide Delivery with Credit Card phone orders up to 4pm (E.S.T.) Monday to Friday. Quality products at direct import prices, means you save up to 50%!

Regards, Jack O'Donnell, Managing Director

Digital Multimeter Kit

" How cheap can you get? This little digital multimeter has no less that 19 ranges, including resistance, transistor gain measurement & 10 amp DC range, all for just under thirty dollars." Silicon Chip Magazine June 1995.

Amazing Price!! Probably the most useful kit you will ever build!

Without a doubt the trusty multimeter is the most used piece of test equipment in everyday electronics! This fantastic meter includes all the parts required to complete a fully operational digital multimeter. Even the test leads and battery are supplied! With proper care this quality multimeter will last for years. Features: • 19 ranges • Transistor tester • Diode check • 5 DC current ranges (200µA-10A) • 5 resistance ranges (200Ω-2MΩ) • 5 DC volts ranges (200mV-1000V) • 2 AC volts ranges (200V & 750V)

Note: At this price, not available from resellers!

100 ONLY AT THIS AMAZING PRICE!

K 2400 Was $29.95, **NOW Only $14.95**

Automatic Charger Kit for NiCads

Keeps Your Nicads in Top Condition!

(EA July '89) Get 100's more recharge cycles from your nicads. It's now well known that correctly charging nicad cells greatly extends their service life. Here is a fully automatic NiCad battery charger that enables differing charge rates as appropriate for AAA, AA, C, D or 9V cells. Once the battery is charged, the unit automatically switches to trickle charge until you switch it off. It is fully featured, yet surprisingly simple. Requires 12V AC Plug Pack. Features: • Fully punched and screened case • Variable charge rate • Variable timer • Flexible and simple to use • Visual display of charge mode • Nicads cannot be over charged

SPECIAL OFFER! Get FOUR S 4705 AA NiCads, valued at $9.20, FREE with every K 1650!

K 1650 **$39.50**

M 9120 12V AC Plugpack to Suit **$14.50**

Megger Meter Kit

(See EA May '89) This design of an electronic meg-ohm meter features a dual voltage of 500 and 1000V with a large scale meter. It can resolve resistance from 1M to 200M ohm which is ideal for insulation testing

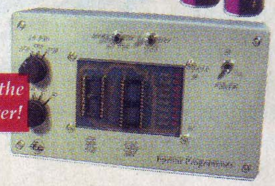
A must for checking earth leakage etc.

Checks insulation breakdown of motors, transformers, cables etc

K 2555 Normally $79, Now **$69**

PC Based EPROM Programmer Kit

A must for the Experimenter!



(See EA Sept '93) This is a great new kit for programming EPROM's from 2716 to 27256. Compares favourably against commercial units costing $$$ more. This kit puts you in the driving seat for under $100. It is flexible enough to be able to program 12.5, 21 and 25V EPROM'S. ***Special Offer This Month:* Buy the K 9525 and receive the K 9526 software on 3.5" diskette, valued at *$19.95* absolutely *FREE!!***

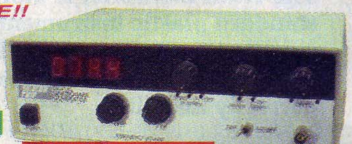
K 9525 **$97.50**

Signal Checker Kit

(See EA Aug '93) If you have ever tried to fix a circuit without a schematic, you'll know how frustrating it can be. This kit can provide you with an indication of the difference between a faulty unit and another, functional unit. It has two sets of probes, which are connected to the same relative point on each circuit. The meter then gives an indication of any differences between the circuits. *SAVE 50%!*

K 2563 Was $39.95, **This Month $19.95**

Digital High Performance Signal Generator Kit



Ideal for Audio Experimenting and Servicing!

(SC July '90) This Digital Sine-Square Wave Generator uses high speed CMOS ICs and a digital filter IC to produce sine and square waves over the frequency range from 0.1Hz to 500kHz in four selectable ranges. It also features a 4-digit frequency readout, with an accuracy of ±2% (±1 digit), and an output level control to vary the amplitude from 0 to 1.2V on sine, and from 0 -5V P-P on square wave. Less than 0.1% harmonic distortion from 0.1Hz to 50kHz, and 0.27% at 80kHz. Output impedance 600Ω, with load impedance 600Ω to infinity. The unit is short circuit protected, and also features solid amplitude stability between ranges.

K 2547 **$155**

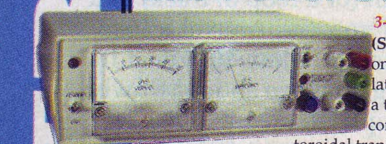
The SCREECHER Car Alarm Kit

An inexpensive theft deterrent for your car!

A very simple, yet extraordinarily effective deterrent to car thieving persons. Controlled by a hidden switch inside your car, this alarm will sound an ear-piercing 110dB piezo siren inside your vehicle when tripped, making life very uncomfortable for anyone there! Features exit and entry delay, with a soft three second pre-warn in case you forget to deactivate it, a super bright LED warning lamp and two trigger inputs. A budget alternative to commercial car alarms!

K 4360 Normally $29.95, **NOW $19.95**

Lab Power Supply Kit



3-50 Volts at up to 5 Amps

(See EA May '85) This supply has been one of our most popular. It includes the latest refinements and is now housed in a tough 'ABS' instrument case. This compact version uses a high efficiency toroidal transformer resulting in less heat and weight. It features dual metering for precise monitoring of the output voltage and current, and switchmode output technology for low ripple output. Supplied with fully screened and punched front and rear panels. *Specifications:* • Output Voltage: 3 to 50V DC • Max Output Current: 5 Amps • Floating Output • Ripple: Less than 5mV • Regulation 0.6% @ 20V

K 3300 Normally $239.95, **Now Only $179**

K 3301 10 Turn Pot for Precise Voltage Adjustment $29.50

K 3302 Independent Fixed ±12V Rails $15.95

2A SLA Battery Charger Kit

(See SC July '96) Powered from a 12V cigarette lighter socket, this sealed lead acid (SLA) battery charger provides up to 2 Amps charge current for 12V batteries of up to 6.5Ah capacity. It supplies an initial charging current of 2A to a discharged battery, and this current will gradually decrease as the cell reaches a fully charged state. This efficient step-up switch mode design includes reverse polarity and fuse protection and charges SLA cells to an end point voltage of 13.8V. Kit includes screened Jiffy box case and cigarette lighter plug. Ideal for camping, boats etc.

Charge Gel Cells From you Car Cigarette Lighter Socket! Great for Camping, RVs, etc

K 1690 **$39.95**

LED Digital Tachometer Kit

Suits all 4, 6, 8 Cylinder Cars. Works on Kettering & Hall Effect Ignition Systems

(See SC Aug '91) Have you ever wondered how many revs your car's engine is doing at 100km/h or at any speed for that matter? This digital tachometer will tell you. It works with all ignitions from Kettering to Hall Effect systems and with 4, 6 and 8 cylinder cars. This tachometer features a bright 4-digit readout that indicates 0-9900 RPM with a resolution of 100 RPM. This unit will work with just about any ignition system. Only three connections are required to connect the unit to your car: one to the negative terminal of the coil and two for power (+12V and GND).

K 4320 Was $34.00, **This Month $25**

OVERNIGHT DELIVERY

100mm Super Carbon Fibre Speakers *2 for 1* Special!

These amazing little speakers will impress you and your friends. Carbon fibre is a new high tech material from which these speaker cones are made. Complimented with Barium Ferrite Magnets the results are simply amazing. 16 ohm voice coils make multi-speaker installations a breeze. Weather-proof design means they are fantastic for cars, boats, homes etc.

C 0643 Normally $39.95 ea,

This Month *BUY* 2 *FOR* **$39.95**

HURRY! Stocks are Strictly Limited!

Natural Anodised Rack Cases

UP TO *25%* OFF!

Overall depth 255mm. Mounting hole centres conform exactly to international racking specifications both vertically and horizontally.

Features: • Natural anodised finish • Aluminium construction with removable top and bottom steel cover panels • All dimensions conform to the International Standard • Vented lid • Individually packaged • Supplied in Flat Pack Form - Easily assembled in minutes.

Cat No.	Unit Height	Height (mm)	Internal Height (mm)	Front Panel Finish	Normally	This Month
H 5021	1U	44	38	Natural Anodised	$77	$57
H 5022	2U	88	79	Natural Anodised	$92	$72
H 5023	3U	132	122	Natural Anodised	$99	$79

Dual Alarm Clock Radio Telephone

Audio Line CRT 4

An alarm clock radio with two independent alarm time settings. The alarm, either buzzer or radio automatically mutes when the phone is picked up.

Features: • AM/FM Radio • 2 Independent Alarms • Snooze Facility • Radio or Buzzer Alarm • Switchable Tone or Pulse Dialling • Recall for Access to Telstra's "Easycall" Facilities • Last Number Redial • Adjustable Ringer Volume

Hurry, Stocks Strictly Limited. Not Available From Altronic Dealers.

A 0500 Normally $99.00 This Month **$69**

Keychain Laser Pointer

This novel laser pointer weighs only 45 grams, with the batteries, and comes complete with a keychain. Measuring only 61mm long by 14mm in diameter, it's not much bigger than many keys! It provides a very intense beam that can travel up to 50m, projecting a bright red dot onto the surface it is aimed at. Ideal for lectures, seminars, building sites and guided tours, and much less intrusive than a normal stick pointer. Push-to-activate operation. Uses two button batteries (included!).

Elsewhere, pay up to $179!

A 0201 **$69**

"Easy Start" Jump Starter

A 0295 **$39.95**

Have you ever had a flat battery and didn't have a set of jumper leads? You need Easy Start; it allows the jump starting of a car via the cigarette lighter socket. One end plugs into the "good" car's lighter socket, whilst the other end is plugged into the "flat" car's lighter socket. Then the "good" car's engine is left running for about 5 minutes, after which the "flat" car should start. The unit has three charging LEDs to let you know when the other car is ready for a start attempt. It's clean, easy to use (even for the non-mechanically minded), and a lot less intimidating than a set of high current jumper leads! It's also safe for EFI equipped cars, whereas jumper leads can cause expensive damage to engine management systems, Fits into a glovebox or under a seat. Operating instructions are included.

Simply Plugs Into Your Cigarette Lighter Socket. No Greasy Hands or Fiddling About Under the Bonnet in the Dark!

CADIK Gas Iron

The advanced CADIK Soldering Iron offers a convenience and a range of functions that redefine the limits of soldering.

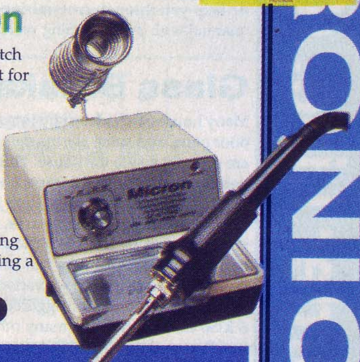
Features: • See through gas chamber • Built in ignition cap • Uses standard butane gas • Comes with safety bench stand • Supplied with bonus blow torch tip, bench stand and replacement lighter flints

With a sleek, pen like design and self-contained butane power it is easily carried and ready for use anywhere. One single refill of the iron's gas reservoir (from a standard butane refill can) allows up to 60 minutes of continuous use with temperatures ranging from 400°C to 1300°C. A blow torch attachment operates at temperatures in excess of 1300°C which makes it the perfect heat tool for heavy soldering jobs, brazing, silver soldering or heat shrink tubing.

T 2500 **$39.95**

AMAZING BONUS THIS MONTH!
Get a T 2447 Butane Gas Refill and a T 1230 Microwick Twin Pack desoldering braid, valued at **$11.90 *FREE*** with every T 2500 CADIK Gas Iron!

Micron Soldering Station



The *MICRON* soldering station employs electronic switch mode circuitry in lieu of a mains transformer. Excellent for all general purpose and production soldering.

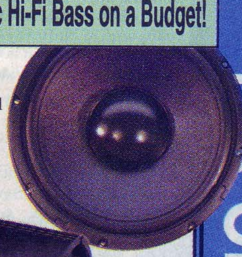
Features: • High insulation ceramic heating element • Rapid heat-up and instant recovery • Heater insulation of over 100MΩ • A zero voltage circuit ensures no high voltage spikes or magnetic field are present at the tip to damage sensitive components • Continuous temperature adjustable from 250° to 430°C (480° to 800°F) • Grounded power cord • Selecting the desired operating temperature is as simple as turning a knob. ***Now Supplied with Long-Lasting Iron Clad Tip!***

T 2443 Normally $129 This Month **$99**

BONUS OFFER!!
This month only, receive a T 1200 200g Solder roll, AND a T 1230 Microwick Twin Pack desoldering braid, together valued at $14.45 FREE with every T 2443!

12" Subwoofer Driver

Fantastic Hi-Fi Bass on a Budget!



Specified for the sole purpose of producing denture loosening bass, this 8 ohm, 300mm driver is ideal for subwoofer installations. Rated at a true **100W RMS continuous**, it can handle prodigious amounts of music power! It features a poly emulsion coated cone, which has the lightness of paper with the rigidity of polypropylene, minimising cone flex and distortion.with a foam surround, high-efficiency and low-Q. Fantastic addition to a hi-fi or home theatre system to add that extra wallop!

Fo 25Hz, **Qts** 0.342, **Vas** 207.8L, **Pmax** 100 WRMS

C 3100 1997 RRP $99, NOW **$79**

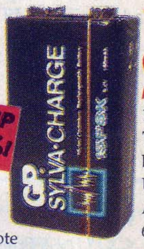
12V DC - 240VAC 125W Inverter

This incredible little inverter provides up to 125W of 240V power from your car cigarette lighter socket. Features battery status indicator and power on LED, and is fitted with a standard 3-pin socket, so it doesn't need one of those nasty adaptors! We set this unit up on a car battery, and connected it to power our entire A/V room setup, which includes a surround sound amp, VCR, speaker selector unit AND a huge 68cm TV, and cranked up the volume. It ran the lot, and with a perfect TV picture as well! It measures only 125L x 130W x 55H, so it will fit into a glovebox! Perfect for camping, RVs etc. Supplied with cigarette lighter plug input lead.

Of the many similar inverters we've tested, this unit outperforms the lot!

M 8105 **$149**

9V NiCd Battery Sellout



SAVE UP TO 60%!

We're clearing out our current stocks of 9V NiCads to make way for our new line! These high quality cells can give hundreds of charge cycles, and will pay for themselves in next to no time. Applications include radios, piezo igniters, kit projects, retic controllers, remote controls and many more! 100mAh current capacity with an 8.4V nominal terminal voltage.

Note: S 5124 is not available from resellers

S 5124 Normally $17.95 ea,

This Month **$10** ea, or 2 for **$15**

12V 4Ah Premium Grade Gel Cell

PRODUCT CLEARANCE! We've *SLASHED* the price of our 12V 4Ah gel cells, so pick up a great bargain while stocks last! These premium grade cells are ideal for alarm battery backups, metal detector belt packs, UPS's, kit projects, lamps etc. Huge 4 Ampere Hour current capacity. Dimensions 68W x 100H x 90L. *Note: Not available from resellers.*

S 5085 Normally $32.95,

This Month Only **$19.95** ea,

or 2 for **$32.95**

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ALTRONICS COMPONENTS

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ALTRONICS

8 Sector Security System

Simple to connect up and program! Includes comprehensive instructions and programming worksheet!

Protect your home and valuables with one of these state-of-the-art security systems. Statistics indicate that the majority of people only install security systems after they have been burgled. Avoid the trauma of being robbed by installing one of these systems at a fraction of similar commercial units.

This alarm is an extraordinarily flexible system which represents excellent value for money! The system core is a module containing the alarm circuitry and backup battery, which is hidden inside the house. The system is controlled via a remotely wired keypad located near the point of entry for convenient arming and disarming of the system, and also programming the many options available in this alarm. Up to six separate sectors can be wired in, as well as a separate fire alarm input and a tamper loop. The panic input can be set up as a silent (duress) alarm if required. Sectors can use a combination of normally open or closed sensors and each is supervised by an end-of-line resistor. Main cabinet, keypad and PIRs are tamper switch protected. FEATURES: • Master code, 5 user codes, panic and "one time" codes • Battery backup with trickle charger • EOL resistors to monitor sector integrity • Sector bypass • Quick arming option • User settable entry, exit and alarm times • 13 different presettable sector types (delay, instant, 24Hr, panic etc) • Preset number of code attempts before alarm sounds • 24Hr type inputs • All functions can be programmed via keypad • Sound and LED prompts during programming to help you through customising your system • Comprehensive installation manual with programming worksheet.

Incredible Alarm System Package Deal Normally Worth $475!

Limited to the First 50 Callers!

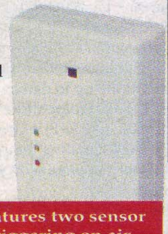
ORDER ONE OF THESE PACKAGE DEALS AND SAVE $150.

Alarm package includes the main module (S 5350), keypad (S 5355), two PIR's (two x S 5315), plugpack (M 9128) and backup battery (S 5075). Free bonus package comprises blue strobe (S 5455), siren cover (S 5460), four small window stickers (two x S 5405), two large stickers (two x S 5400) and 12V siren (S 6130).

That's enough to cover an average size home!

Alarm System Package **$339** **BARGAIN**

Glass Breakage Detector

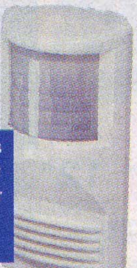


Many houses are entered by intruders breaking a window or door pane, and some alarms may not pick them up until they are actually inside the house. This acoustic glass breakage detector responds to the impact on and breakage of glass, and will trigger your security system immediately. One sensor can be used to cover a large area, regardless of the number of windows. It suits Normally Closed circuits and has a NC tamper switch. Sensitivity can be adjusted internally, and three LEDs indicate the activation of air pressure sensor, sound filter and alarm (triggered) output. Suits the S 5350 alarm panel, and many other security systems, too. Powered by 10-16V DC, setup instructions are included.

Features two sensor triggering on air pressure and sound for reliable operation.

S 5365 Glass Breakage Detector **$39.95**

Passive Infra Red (PIR) Detector

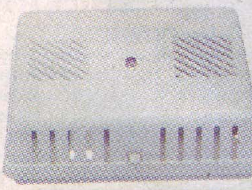


The S 5315 PIR detector incorporates a pulse count circuit to minimise false triggering, "sense" LED which can be disabled, tamper switch and relay output. Range is up to 12m horizontal when mounted 2m from the floor, with a 90° detection angle. This coverage can be changed by sliding the PCB up or down in its housing. It can be configured as Normally Open or Normally Closed, and has variable sensitivity. It is the ideal sensor for the S 5350 alarm, but it can be used with a wide range of other security systems.

Incorporates Pulse Count Circuitry for Reliable Triggering

S 5315 PIR Detector **$49**

Smoke Detector



Fire in homes and business is becoming an increasingly high profile issue these days, and as a result smoke detectors are being installed in many houses across Australia. This detector can be connected to the S 5350's FIRE input, triggering an alarm in the event of a fire, which can not only alert neighbours, but perhaps save lives as well. Powered by 12V DC, and covers up to 70 square meters, depending on room shape. Can be configured to NC or NO output, so it suits the S 5350 and many other systems. An essential component of a comprehensive home security system.

Smoke Detectors can SAVE LIVES! Connect one to your security system!

S 5370 Smoke Detector **$59**

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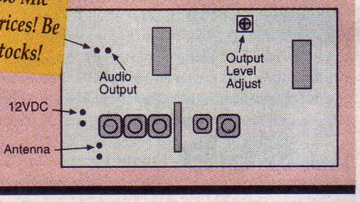

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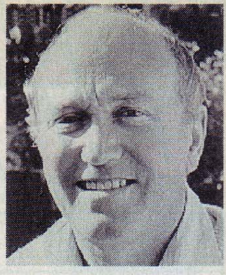


By JOHN HILL

A look at signal tracing, Pt.1

About 10 years ago, I drove away from a house in Melbourne with a car full of old radios and other gear. Back then I had no idea what good buying it all was for $200. At that stage of my collecting career, I was quite unaware of the value of mid-1930s Radiolettes – and there were two of them in the boot when I drove off.

Apart from some very collectible radio receivers, my haul also included some bound volumes of *Radio and Hobbies* and a test instrument that I assumed was a radio frequency RF generator.

Only a few weeks earlier I had obtained a working RF generator which was in excellent condition. I therefore paid little attention to this latest acquisition and it was placed in a dark corner of a cupboard where it lived in forgotten limbo for nearly a decade.

However, a recent visit to a collector friend jogged my memory when he showed me his signal tracer. It looked very similar to the instrument I had assigned to the cupboard many years ago, so I checked it out as soon as I returned home.

Sure enough, when my long forgotten "RF generator" was removed from its hiding place, it turned out to be a signal tracer – and a reasonably good one at that. It was a tuned type tracer and was called a "Healing Dynamic Signalizer", to quote the name on the front panel. The old tracer appeared to be of early postwar manufacture.

Coming into vintage radio with little or no experience can be a decided disadvantage at times. In this instance I had acquired quite a useful piece of test equipment but I didn't know what it was and promptly forgot all about it.

Getting it going again

It was time for some restoration work. There is not much point in having a signal tracer that doesn't work.

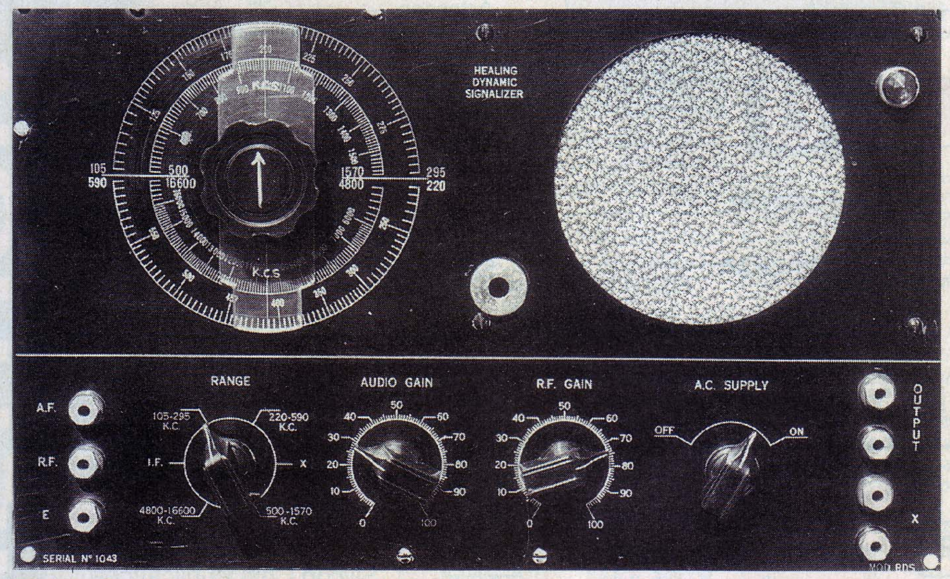
Restoring an old signal tracer is not unlike restoring a simple radio receiver. In fact, a signal tracer will receive any strong local transmission in a broadly tuned manner, having much the same degree of selectivity as a crystal set.

The Healing has a 6D6 RF amplifier, a detector which uses the diodes in the first audio valve, two audio stages employing 6B6 and 6V6 valves, plus a high-tension DC circuit similar to most valve radios (the loudspeaker field coil is used as a choke). The rectifier is a 5Y3.

As the tracer was in almost completely original condition, its restoration was a simple matter of replacing the paper and electrolytic capacitors, plus a few carbon resistors that had gone high with age. All four tuning coils were OK, likewise the power transformer, the loudspeaker field coil and the output transformer.

All four valves checked out as new and were in excellent condition. This is not surprising – a signal tracer is a test instrument, not a radio receiver and, as such, it would have had only intermittent use.

Because of this, one would not ex-



This is the front control panel of Healing signal tracer. The output sockets connect to the speaker voice coil, while the X sockets allow an external coil to be connected to extend the instrument's range of frequencies.

pect that the single gang tuning capacitor would need attention. Not so!

The problem here was that the gang had been poorly mounted and the alignment of the control shaft to the front panel was out by several degrees. In fact, the alignment was so bad that the dial cursor was touching the panel on one side while there was a 10mm gap on the other. Something had to be done as the crooked cursor looked terrible.

Perhaps the reason for this poorly installed tuning capacitor was the fact that the chassis was not jig-drilled to accurately locate the mounting holes. Instead, the original holes had been marked out using a pencil and these markings were still clearly visible. Unfortunately, the hole positions were way out from where they should have been.

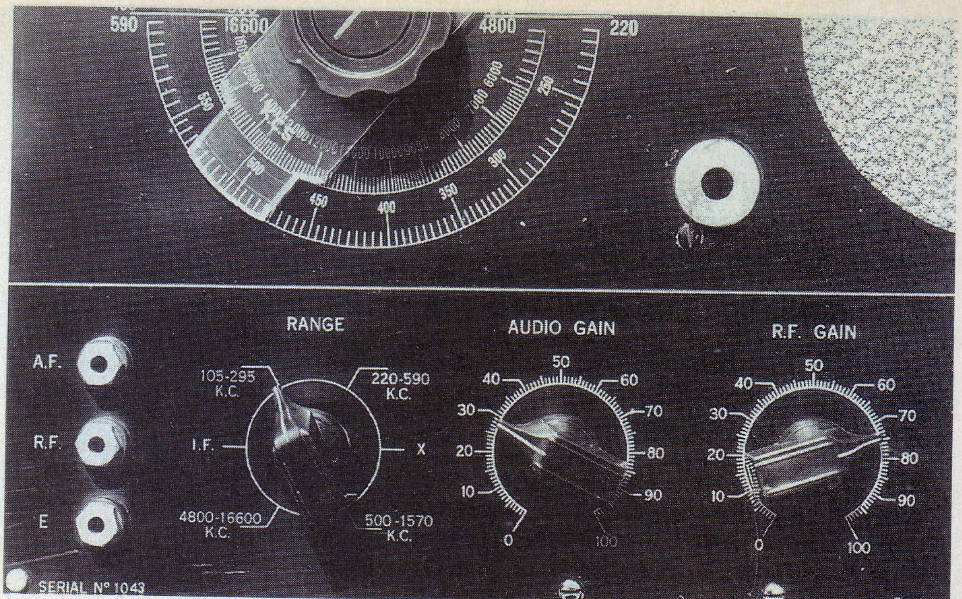
To correct this misalignment problem, the mounting holes were elongated with a small round file and the tuning capacitor raised slightly using washers. The unit was then carefully adjusted so that the control shaft was centred in the dial aperture at right angles to the front panel.

But that was not the only problem. The general construction quality of the Dynamic Signalizer was dreadful. For example, many long screw threads had been shortened with side cutters, which not only produced sharp edges but also made it difficult to remove the nuts. And connections to the front panel sockets were soldered to the threads instead of to solder tags.

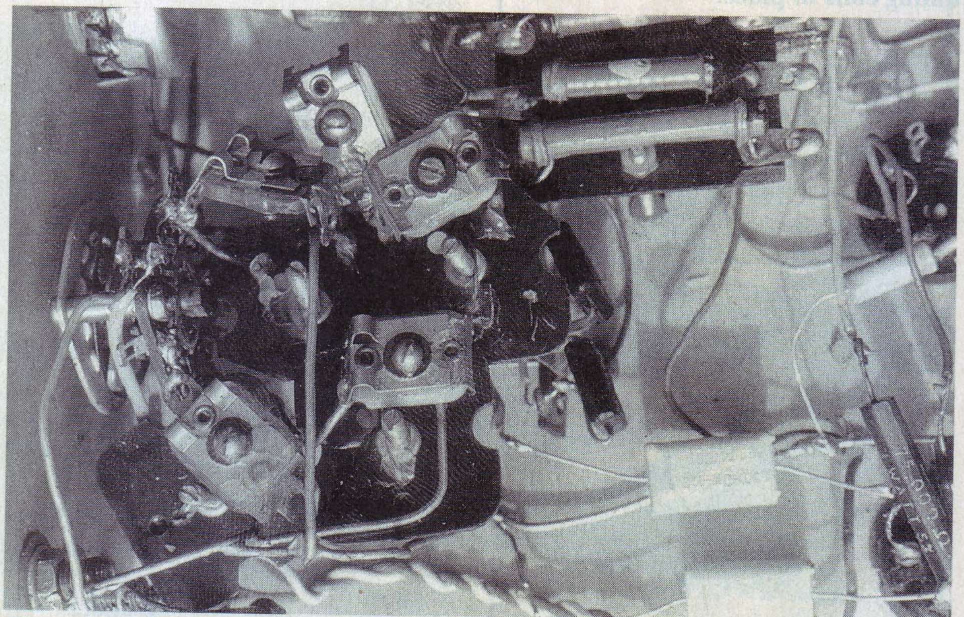
On the other hand, the front control panel looks quite good. It is painted black, with most of the control markings stencilled on in white. The frequency range selector switch and the tuning dial are colour coded for their respective frequency bands in white, blue, green and red.

The condition of the front panel paint work was excellent and it responded well to a gentle rub down with automotive cut and polish compound. A couple of small bare spots were touched up with a black "Texta" pen.

One minor problem with the front panel was a hole of about 14mm diameter in the top right corner. This somewhat roughly drilled hole detracted from the panel's otherwise good appearance. This problem was solved by fitting a green panel light, which tidied up that corner of the panel quite nicely The original panel light was disconnected.



This view shows the probe sockets (left), the range (or band) selector switch, and the audio and RF (radio frequency) gain controls. The painted-on panel markings are in very good condition for a 50-year old instrument.



This under-chassis view shows the cluster of tuning coils and their associated trimmer capacitors. These coils are connected to the selector switch at left.

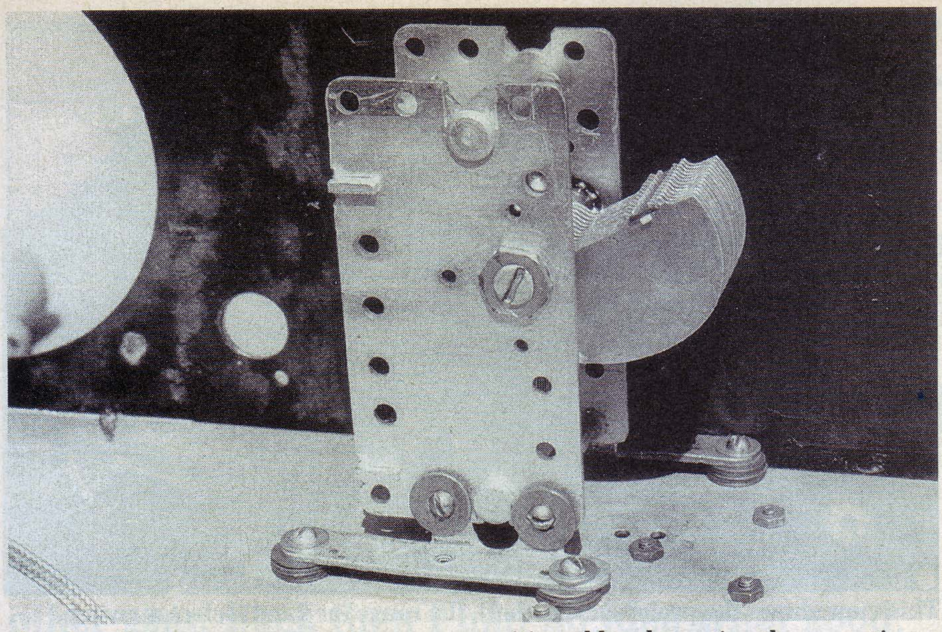
Switching on

With the restoration almost complete, it was time to see if the old Signalizer would work. At switch-on the panel light lit up, as did the four valves. After about 15 seconds or so a quiet hum could be heard from the speaker. All seemed well!

The touch of a finger on the audio socket produced a loud response from the speaker which was easily regulated by using the audio gain control. Similarly, touching a finger on the radio frequency (RF) socket brought in a soft response from a local radio station. Rotating the dial tuned in the station and it responded to both the audio and radio frequency gain controls.

When checking the tracer's tuning ranges with an RF generator, it was found that the dial was not particularly well aligned to the tuning capacitor on all four tuning ranges. This was corrected by adjusting the tuning coils.

These coils are fitted with adjustable iron cores for aligning the low frequency end of the range and trimmers for adjustments at the high frequency end. After completing these



The Signalizer's tuning capacitor was repositioned by elongating the mounting holes and packing it with washers. The nuts on top of the chassis hold the tuning coils in place.

A Rola 5-inch (125mm) electrodynamic loudspeaker is used in the signal tracer. Note the missing mounting washer and nut – typical of the very rough building quality evident throughout the instrument.

simple alignment procedures, the dial lined up quite accurately on all four frequency bands.

The Healing Dynamic Signalizer was just about ready for trials but there was one remaining problem. After operating the unit for half an hour or so, the speaker field winding became uncomfortably hot. Field coils should operate at warm temperatures – not hot. For some reason or other the high tension current appeared to be excessive.

Substitute valves were tried one at a time but this failed to reduce the HT current. Sometimes a faulty valve can consume a lot more current than it should.

In order to reduce the HT current, the 150Ω back-bias resistor for the 6V6 output valve was increased to 250Ω. In addition to this, a 300Ω resistor was placed between the RF gain control potentiometer and the cathode of the RF valve.

Because the RF gain control is, in fact, a variable cathode resistor, it supplies no resistance (and thus no bias) at all when it is fully on (hence the 300Ω cathode resistor). Backing off the RF gain control to zero when using the audio section of the instrument helps to slightly reduce HT consumption.

These two minor circuit alterations cut back the high tension current by about 6mA. While the field coil still gets fairly warm, it runs much cooler than before.

Making the probe

All that remained at this stage was to make up some suitable probes and a chassis lead. But this simple project turned out to be more time consuming than expected.

When one lives in a small country town, shopping for items such as banana plugs, shielded wire, and RF probes can prove a difficult task. So it is usually a case of improvise with whatever is available at home or travel 80km to a major electronics dealer for suitable supplies.

The chassis lead was no trouble to make. With an old style banana plug at one end and an alligator clip at the other, it did not take long to complete. The lead itself was made of some moderately heavy, yet fairly flexible, plastic covered multi-strand wire.

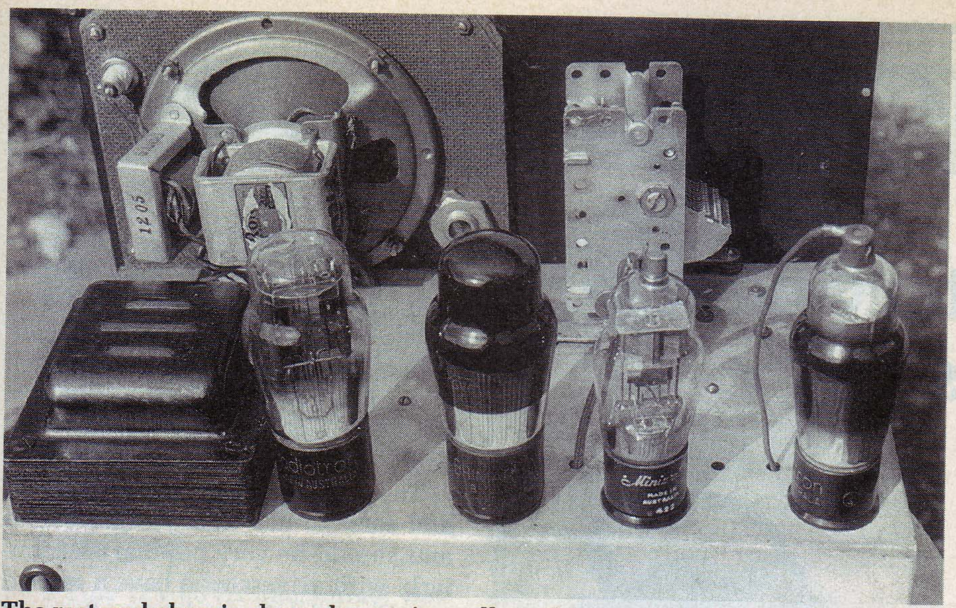
Unfortunately, I couldn't find a suitable length of shielded wire to make the audio lead. All that was available was a single length of the same wire used to make the chassis lead. And non-shielded audio leads are not usually recommended.

It was decided to make up a dual-purpose RF/AF probe using unshielded wire. The probe would allow the tracer to be tested and a shielded lead could be fitted at some stage in the future. The idea behind the dual-purpose strategy was that the probe could be changed from RF to AF at the flick of a switch.

A suitable RF probe for a signal tracer, such as the Dynamic Signalizer, requires a small high-voltage capacitor of 3-5pF to be mounted in the probe tip itself. This is necessary to prevent the probe lead from loading the receiver's RF circuits and detuning them.

Unfortunately, I didn't have a suitable capacitor available and so I decided to make one by twisting two short lengths of enamel-covered copper wire together. With the aid of a capacitance meter and a high voltage megohmmeter, the home-made 4pF 1000V capacitor passed all tests.

The probe was made up by installing the home-made capacitor and the



The restored chassis cleaned up quite well, as this top view shows. The valves, from left, are: 5Y3, 6V6, 6B6 and 6D6.

The fully-restored unit retains its original cabinet finish. The unit should prove invaluable for tracing problems in old radio receivers.

switch in a "Texta" pen body. The completed probe was then tested with an ohmmeter. When the switch was in the RF probe position, the capacitor was switched into circuit and the ohmmeter indicated open circuit. Conversely, with the switch in the AF probe position, the capacitor was shorted and the meter responded accordingly.

All that remained was to try the probe with the Signalizer to see if it worked properly. As an RF probe, the unit functioned perfectly. But when switched to the AF position and plugged into the audio socket, the hum was overpowering.

However, because the audio section of the Signalizer has two stages, it is not necessary to operate the gain control at full on; a setting of 20 on a scale of 100 is where the instrument works best. At that level of amplification the hum is barely audible and I won't bother to make another probe with a shielded lead.

So the old Healing Dynamic Signalizer is now fully operational. Next month we will try it out and trace through the circuit of a receiver. **SC**

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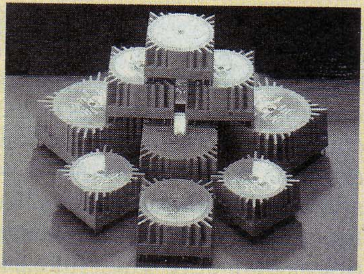

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PRODUCT SHOWCASE

Easy-start battery charger from Altronics

This clever device should largely eliminate the need to carry jumper cables to start your car or somebody else's. Called the "Easy-Start" it is an in-cable battery charger which plugs into the cigarette lighter sockets of both cars. The Easy-Start draws current from the car with the good battery, steps up the voltage a little and feeds it to the cigarette lighter socket of the car with the dead battery.

After being connected for five minutes, the manufacturer claims that most cars with dead batteries should have received enough charge to be able to start. Whether that is true or not in most cases, we like the concept because it eliminates the use of jumper cables. Jumper cables are potentially damaging to any car with an engine management computer and most car makers warn against their use. Using jumper cables also brings the possibility of battery explosions and serious damage to the cars concerned.

Our examination of the Easy-Start reveals that it employs a switchmode step-up circuit and probably charges at somewhere in the region of five amps, based on the appearance of the components and the gauge of the connecting cables. No performance data is given on the packaging.

When the Easy-Start is first connected, a green LED is lit and then when it is charging the dead battery, three red LEDs light in sequence. The overall cable length is 5.5 metres.

The whole package is much easier and safer to use than jumper cables and should be very popular, particularly with drivers who have a second vehicle which is not driven often and therefore prone to the occasional dead battery.

The Easy Start is available from Altronics in Perth or any Altronics reseller. It is presently available at an introductory price of $39.95. (Cat A-0295).

Fluke 36 clamp meter

The Fluke 36 measures true RMS current and voltage, DC current and voltage, resistance and continuity and shows readings on a 2000 count liquid crystal display. Ranges are 0-600A AC, 0-1000A DC, 600V and 0-200Ω. The continuity beeper function operates for resistances of less than 30Ω. The Fluke 36 has a maximum reading hold function for checking inrush currents on motors or the maximum load on a circuit.

Designed to UL, CSA and TUV, the Fluke complies with IEC 1010 safety standards. It comes with Fluke Hard Point test leads, a protective soft carrying case, a 9V battery and is covered by a one-year warranty.

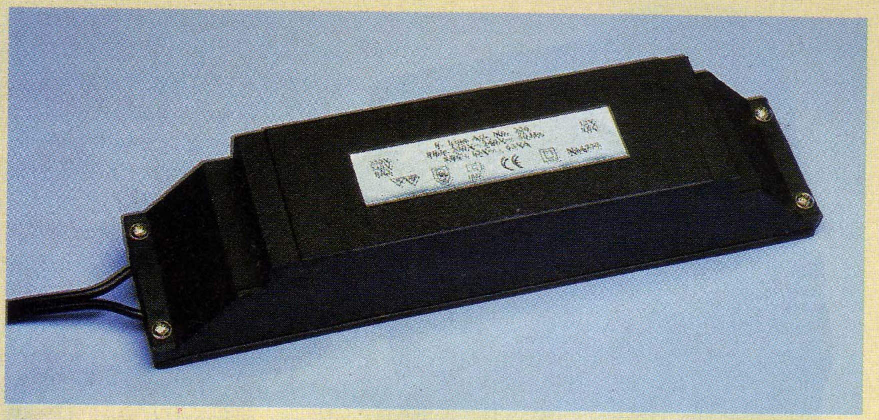
For more information, contact Obiat Pty Ltd, 129 Queen Street, Beaconsfield, NSW 2014. Phone (02) 9698 4111; fax (02) 9699 9170.

Low cost handheld programmer

Stag Programmers has launched the P301, a full-featured handheld portable programmer which includes a PC Windows and DOS software package for full control via a PC. The Stag P301 also has wireless communication with a host PC through an infrared IrDA interface, as well as an RS232 port.

The P301 provides programming for up to 32-bit structures based on 8-bit devices through a single wide blade socket capable of accommodating 8, 24, 28 and 32-pin DIP packages with either 0.3-inch or 0.6-inch pitch. It will program EPROMs, EEPROMs, serial EEPROMs and Flash/CMOS PROMs. Adapters are also available for PLCC, TSOP and SOIC devices.

The device support library is fully updatable and is held in non-volatile



63VA transformer is wired

This 12V 60VA transformer was designed for use with halogen lighting in homes.

Fully encapsulated and enclosed, it is intended to be mounted in the ceiling space. However, it could be used in almost any application where a continuously rated 12V 63VA transformer is required. Its overall dimensions are 207 x 48 x 42mm.

A particular attraction of the transformer is that it comes fitted with a 2-core power flex and a moulded 2-pin power plug. The transformer is protected against overloads by a thermal cutout which is in series with the primary winding. The secondary connection is via two screw terminals which are shrouded by a plastic cover.

The transformer is available from all Jaycar Electronics stores at $24.95 (Cat. MP-3050).

flash memory which means that no additional library support ROMs are required.

Device selection is menu driven, either by the manufacturer's part name or automatically via the electronic ID to select the programming algorithm for the device in the socket. Stag also makes device library updates available free-of-charge on its Web site.

The unit is fitted with 128Kb of RAM as standard, expandible to 512Kb or 1Mb and devices are programmed in blocks if the RAM fitted is smaller than the device. 8-bit, 16-bit and 32-bit structures are supported and are automatically handled by "Interlace 2", Stag's method of splitting and shuffling data without the intervention of the user.

Either battery or mains-powered for both portable and desktop applications, the P301 features a 4 x 20 character alphanumeric reflective supertwist LCD and 23 dedicated function and cursor keys. The P301's battery can either be trickle charged using the supplied mains adapter or boost charged using the optional off-line charging unit.

For more information, call Emona Instruments on (02) 9519 3933 or fax on (02) 9550 1378.

Thin-film power chip resistors

New thin-film power chip resistors recently introduced by Philips are among the first to offer the same pulse power capability as leaded products. As well, the new PRC202 resistors can handle higher pulse surges and significantly higher current densities than equivalent thick-film types.

The resistors are supplied in the same package (ie, 1218) as the Philips thick-film PRC201 series. This is the same size as the standard 1812 package but with the terminations on the longer side. The PRC201 range has already demonstrated that this significantly improves heat transfer and increases the strength of the solder joint. It also reduces stresses and hence improves reliability.

Nearest equivalents to the new PRC202 thin-film series offering comparable continuous power handling

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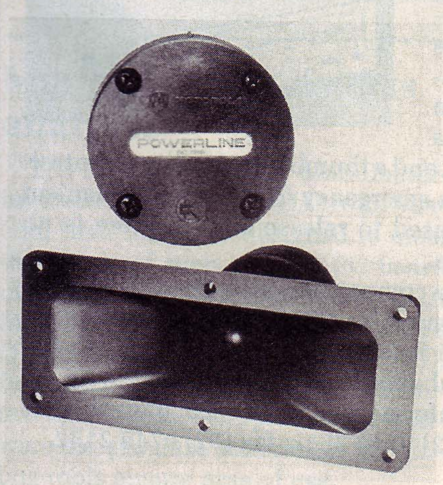

The new Powerline series of Motorola's 2kHz Horn speakers incorporate protection circuitry which allows them to be used safely with amplifiers rated as high as 400 watts. This results in a product that is practically blowout proof. Based upon extensive testing, Motorola is offering a 36 month money back guarantee on this product should it burn out.

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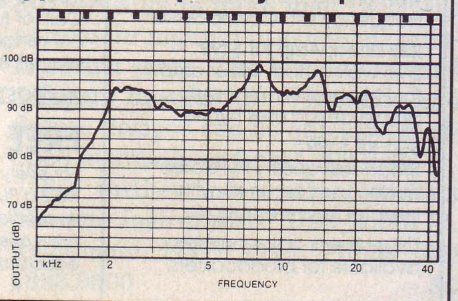
Typ. Imp: appears as a 0.3μF capacitor

Typical Frequency Response



capability are available only in the larger 2512 size.

The new resistors are available in values from 0.1Ω to 100Ω with tolerances down to ±1% and with temperature coefficients of less than 200 ppm for values between 0.1Ω and 1Ω, and 50 ppm for values between 1Ω and 100Ω. They are supplied in blister tape and can be placed by all standard surface-mount assembly machines.

For further information, contact Philips Components, 34 Waterloo Road, North Ryde, NSW 2113. Phone (02) 9805 4479; fax (02) 9805 4466.

125W 12VDC to 230VAC inverter

There are quite a few different 12V to 240VAC inverters on the market but few are as compact and as neatly packaged as this one. It comes in a neat extruded aluminium case which functions as the heatsink for the internal electronics. It has a single 3-pin AC outlet on the top and a short cable fitted with a cigarette lighter plug for the DC input. There are no switches – you just plug it in and it goes.

Overall dimensions of the inverter are 128mm wide, 122mm long and 53mm high.

There are three LEDs on the top panel – one indicates that it is operating, while the other two indicate whether the battery is good or low.

The output waveform is a modified square wave type and it is silent in operation. We tested the unit by plugging it into a cigarette lighter socket and then measured the RMS output voltage when the unit was driving a standard lamp fitted with two 60W globes. With around 12.6V, it deliv-

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FMTX5 Kit $98
Both a FMTX2A & FMTX2B on 1 PCB. Pwt & audio routed.

FME500 Kit $499
Broadcast specs. PLL 0.5 to 1 watt output narrowcast TX kit. Frequency set with Dip Switch.

220 Linear Amp Kit $499
2-15 watt output linear amp for FM band 50mW input. Simple design uses hybrid.

SG1 Kit $399
Broadcast quality FM stereo coder. Uses op amps with selectable pre-emphasis.

Other linear amps and kits available for broadcasters.

AWA FM721 FM-Tx board $19
Modify them as a 1 watt op Narrowcast Tx. Lots of good RF bits on PCB.

AWA FM721 FM-Rx board $10
The complementary receiver for the above Tx. Full circuits provided for Rx or Tx. Xtals have been disabled.

MAX Kit for PCs $169
Talk to the real world from a PC. 7 relays, ADC, DAC 8 TTL inputs & stepper driver with sample basic programs.

ETI 1623 kit for PCs $69
24 lines as inputs or outputs DS-PTH-PCB and all parts. Easy to build, low cost.

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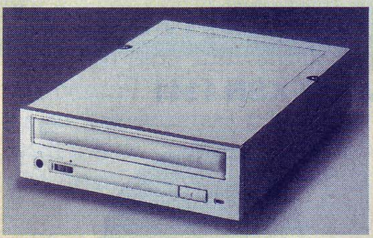
Teac 12-speed CD-ROM

Teac Corporation in Japan has released a 12-speed CD-ROM drive, the CD-512. The CD-512 features a data transfer rate of 1.8Mb/s and a choice of ATAPI (CD-512E) or SCSI (CD-512S) interface, MW DMA Mode 2 and PIO Mode 4 to minimise CPU utilisation (CD-512E), motorised tray loading, an MTBF of 100 000 hours (10% duty cycle), horizontal or vertical mounting and compliancy to Windows 95 and Window NT.



The CD-512 has an industry standard 5.25-inch format. The front panels controls include an eject button, a stereo mini jack and a thumbwheel volume control. There is also an emergency CD release mechanism which can be used to release a CD if there is no power available.

This drive is compatible with the CD-DA, CD-ROM (mode 1, mode 2), CD-ROM XA mode-2 (form 1, form 2) Multi Session Photo CD, CD-I, Video-CD, CD Plus and Enhanced CD disc formats.

For further information, PO Box 25, Bangor NSW 2234. Phone (02) 9749 2633; fax (02) 9749 2152.

ered 200V with one 60W globe on while with two 60W globes the voltage dropped to 140V. At just below 12.6V, the low battery light comes and the unit emits a loud whistle.

Having been warned, we started the motor and the battery voltage rapidly came up to 14V. At this point, it would deliver 200V with one or two 60W lamps on.

The unit should be suitable for many applications, driving mains voltage equipment where no 240VAC is available. It is available from Altronics in Perth or any Altronics reseller. It is priced at $140.00 (Cat. M-8105).

Philips "talking remote" finds itself

With Philips hifi stereo video cassette recorders (models VR656 and VR856), you will always be able to find your remote control. No longer will you need to throw a tantrum or glare at the children whenever the remote control for your VCR or TV has been misplaced.

The new Remote Locator video cassette recorders from Philips "call" the remote device with a "beep, beep" when you press the power button on the deck. And once you've found the remote for the VCR, there's a good chance you won't have to worry about the one that's missing from the TV. The Philips remote is multi-branded and multi-functional, which means it can operate most TVs as well.

Both units are 6-head, hifi stereo VCRs with Incredible Picture(TM) chip circuitry to improve the picture quality. The VR856 model is Multisystem-compatible which means it can record and play back tapes from the various systems in use around the world.

G-Code makes programming a cinch

and the new "Turbo Drive Mechanism" gives faster access to all play, fast forward and rewind functions.

Other features include audio and video front input sockets, digital audio tracking, widescreen-compatible playback, tape counter, NTSC playback (Model VR656 only), PAL, NTSC and SECAM record and playback (Model VR856 only).

Recommended retail prices are $769 for the VR656 and $989 for the VR856. For further information, contact your nearest Philips retailer.

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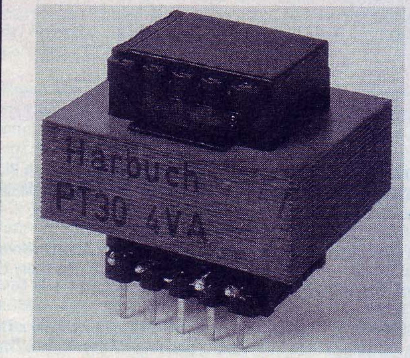

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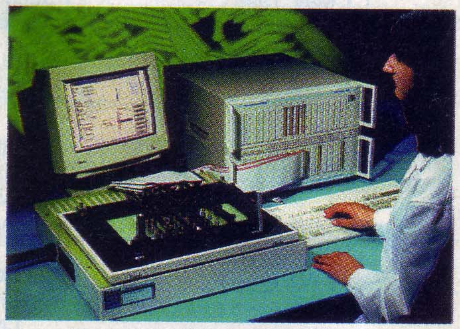
Manufacturing defects analyser

The new 5200 Power Manufacturing Defects Analyser (MDA) from Marconi Instruments is designed to meet the needs of high volume PC board manufacturers. The 5200 Power MDA includes vectorless testing (Marconi's Q-test is configured as standard), Boundary-Scan and new "power-on" test techniques. Comprehensive software for program generation and debug tools ensure ease of use.



With component test speeds said to be several times faster than other automatic test equipment currently available, the 5200 Power MDA excels in situations where high fault coverage and very high throughput are important. In practice, using the 5200 Power MDA results in more than twice the normal throughput in a typical manufacturing setup. The Windows based software ensures test programs and fixture designs can be quickly developed manually or from CAD data.

For further information, contact Marconi Instruments, 1/38 South St, Rydalmere, NSW 2116. Phone (02) 9638 0800. **SC**

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September 1996: VGA Oscilloscope, Pt.3; Infrared Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Feedback On Programmable Ignition (see March 1996); Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; 600W DC-DC Converter For Car Hifi Systems, Pt.1; Infrared Stereo Headphone Link, Pt.2; Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: Adding An Extra Parallel Port To Your Computer; 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; How To Repair Domestic Light Dimmers; Build A Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: CD Recorders – The Next Add-On For Your PC; Active Filter Cleans Up CW Reception; Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Using An Autotransformer To Save Light Bulbs; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source (for Sound Level Meter calibration); Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: Computer Problems: Sorting Out What's At Fault; Cathode Ray Oscilloscopes, Pt.6; PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Madel Railways; Build A Jumbo LED Clock; Audible Continuity Tester; Cathode Ray Oscilloscopes, Pt.6.

PLEASE NOTE: November 1987 to August 1988, October 1988 to March 1989, June 1989, August 1989, May 1990, February 1992, September 1992, November 1992 and December 1992 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.00 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disc at $10 including packing & postage.

Pt.8: More Advantages Of Digital Scopes

Cathode Ray Oscilloscopes

Digital storage scopes excel over analog scopes when displaying multiple inputs or very slow signals. Some DSOs can provide grey scaling or colour gradations to accentuate signal changes while averaging many recurrent waveforms improves the trace and the accuracy of mathematical calculations.

By BRYAN MAHER

It is common to use an oscilloscope to display two (or more) different signals simultaneously, usually to see the timing relationships between them. Let's compare how this is done on analog scopes and digital scopes and then we'll see why the DSO is superior.

In Pt.4 (August 1996 issue) of this series, we described how an analog scope can display two input signals in either alternate or chop modes. The switching principle is shown in Fig.1. Briefly, two input signals, channel 1 and channel 2, are individually attenuated and preamplified in A1 and A2. Then a fast electronic switch, IC1, switches back and forth between channels 1 and 2, to select which signal is displayed on the screen.

In alternate mode, IC1 selects channel 1 signal during all of the first sweep, then switches to channel 2 for all the second sweep. Then channel 1 is displayed again on the third sweep, and so on.

This is not practical at slow sweep speeds, because the first waveform fades away before the CRT beam has time to draw the second. At faster sweep speeds, the screen persistence continues to show the first waveform while the next sweep displays the second. Although they are actually being displayed alternately, you see both waveforms on the screen continually.

But because each input signal triggers its own sweep of the scope independently, all time relation between the two waveform displays is lost. Comparative timing measurements between traces in alternate mode are meaningless. What should you do?

Chop mode

You could select chop mode on your analog scope. Now IC1 rapidly switches back and forth between the two channels, typically at a rate of about 1MHz. The screen displays many chopped up segments of both waveforms, as one of the scope screen photos in this article shows. We've shown a special case here to show the chopping action. As you can see, both traces are chopped up.

This chopping mode is usually not evident because the waveform frequency and chopping speed are unrelated. Normally, all those little segments are blended into two continuous waveforms on the screen. One input signal triggers all sweeps, so comparative timing measurements made between the traces in chop mode are valid.

But here a second disadvantage of chop mode becomes evident. The screen doesn't show what happens in waveform 1 while the scope is busy displaying the next short segment of waveform 2 and vice versa. Half of each signal is invisible. In this way you could miss seeing elusive glitches.

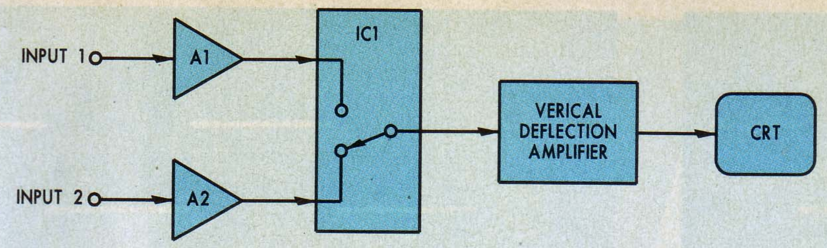


Fig.1: two channel analog scopes have a fast electronic switch (IC1) to select between channels either at the sweep rate which is called alternate mode or at about 1MHz, which is called chop mode.

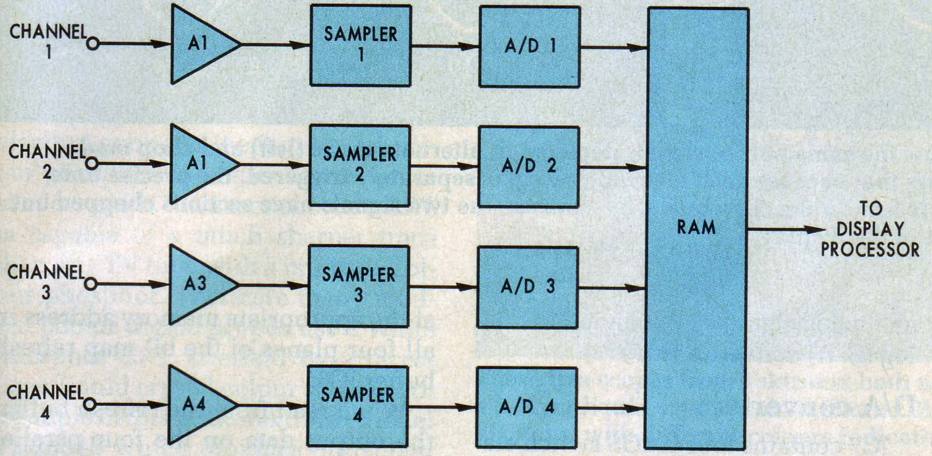


Fig.2: A digital oscilloscope displays multiple inputs by individually preamplifying, sampling and digitising every input signal. The four sets of data are stored in separate areas of RAM before being displayed.

So neither alternate nor chop mode is ideal. What other choice is there?

Two-gun CRTs having separate electron beams were tried but their mechanical alignment proved impossible. Cossor split-beam tubes displayed two inputs validly at any speed but were limited to two signals only.

Today, to investigate timing diagrams in digital circuits, you might need four simultaneous input channels at fast sweep speeds. The only satisfactory answer is to buy a digital storage oscilloscope.

Multiple inputs

Digital scopes can successfully display two, three or four separate input signals simultaneously, at any sweep speed, using a very different technique. The block diagram of Fig.2 gives us an idea of how it's done. Each input signal passes through its own attenuator and analog preamplifier, shown as A1 to A4. From there, each signal is individually sampled and converted in separate A/D converters A/D1 to A/D4. All the digital data from each channel is separately stored in different areas of the fast random access memory (RAM).

The process of reading the contents of the RAM to its display on the screen is complex, especially in Tektronix scopes using InstaVu mode. Suffice to say that neither chop nor alternate procedures are used, and the whole of each waveform is displayed on the screen.

Everything recorded in the RAM is faithfully shown; nothing is lost. The process operates equally well at all sweep speeds, slow or fast.

All timing measurements made on the screen and the phase relationships observed are accurate. In displaying multiple input signals, a digital storage oscilloscope is vastly superior to all analog scopes.

Low frequency displays

If you need to display long pulses or ramp signals, you'll find digital scopes much better than analog scopes. Say you want to observe a ramp signal with a period of 50 seconds. Setting the timebase to 10s/div, the scope would take 100 seconds for one sweep across the screen. That would display two full cycles of the waveform.

If you were to set an analog scope to this low sweep speed (and on most analog scopes, you can't), you would just show one bright green spot, slowly meandering up and down and taking 100 seconds to cross a dark screen. It won't make much sense.

But this sort of waveform is routine to a digital scope. After the signal has executed two full cycles, they will be stored complete in the memory. Then the whole waveform will be continually displayed on the screen, refreshed at the 60Hz rate.

You can observe the linearity of the ramp signal by eye or measure it if your DSO supports a mathematical differentiation routine. Results of changes or adjustments can be seen after the next two cycles are complete.

Grey scaling

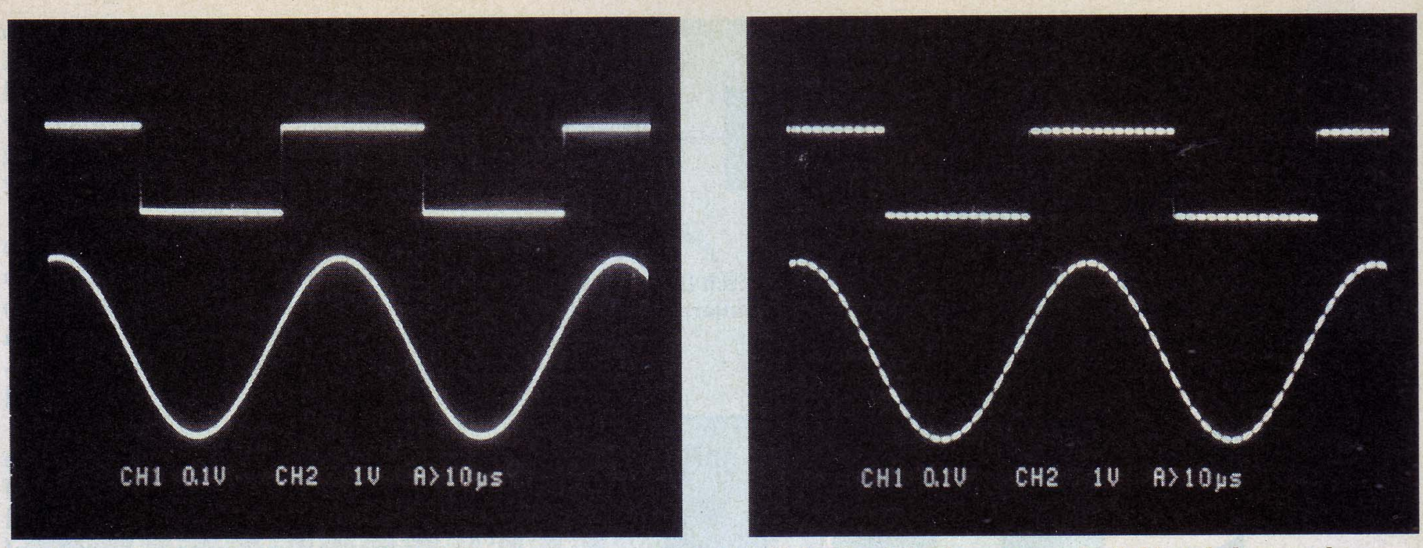
In the past, your trusty analog scope easily displayed compound signals, for example live TV waveforms or digital data which contained intermittent faulty pulses. Your display was brighter in those parts of the signal which repeat more frequently, because at those points thousands of traces were overlaid. Sections of the waveform which continually changed or occurred less often thus appeared less bright.

These brightness gradations let you identify rarely occurring spurious interferences or runt pulses. On the screen they looked different from the normal repetitive signals. Point one in favour of analog scopes!

But the simple digital storage oscilloscope we discussed in last month's issue (Pt.7) can't do this. Remember that is had a 1-bitmap refresh buffer and as such, it could not display signals at varying intensity. The one-bit output has only two possible values, digital high or low. These correspond to the points on the screen being illuminated or not; on or off.

So in that simple sort of DSO we saw in the previous chapter, everything has the same intensity on the screen.

But ideally we want a digital storage scope to be at least as good as analog scopes were in showing compound signals. With that in mind, we would like 16 levels of brightness in the trace. Frequently recurring parts of the signal should be brighter than infrequent anomalies and faulty pulses.



These two analog oscilloscope photos show the same pair of signals depicted in alternate mode (left) and chop mode (right). The problem with alternate mode is that because each alternate sweep is separately triggered, the precise time relationship between the two waveforms is lost. In the chop mode, by contrast, the two signals have sections chopped out and this can lead to glitches being missed in the display.

To achieve this aim, digital oscilloscope designers enlarged the bit map refresh buffer to store four bits (instead of one previously) in each of its memory locations. We imagine this structured as four planes of memory elements, as illustrated in Fig.3.

Each plane is like the single bit memory map depicted last month and contains 307,200 memory cells, arranged in 480 rows, each row containing 640 cells. In each plane, each cell contains a single digital value, 1 or 0; ie, either logic high or low.

As we saw in the previous chapter, the XY address of each cell corresponds to one particular point on the CRT screen raster.

In Fig.3, all four planes of the refresh memory are addressed in parallel. For example, the top left cells in all planes have the same address.

So when the system reads the top left address of the refresh buffer, it reads the contents of the top left cell in each plane simultaneously. The output is then 4-bit data (one bit from each plane) carried on four parallel lines A, B, C, D.

That 4-bit digital data is used to control the brightness of the spot on the screen, by changing the G1-K bias potential on the CRT cathode. But that tube is an analog component, so it requires a varying analog voltage signal on its cathode to alter the electron beam current and trace brightness.

Therefore, the 4-bit digital data read from the bit map refresh buffer on lines A, B, C, D must be converted to an analog signal in the digital to analog (D/A) converter (IC7).

D/A converter

IC7 contains four CMOS switch elements, SA, SB, SC & SD, powered by an accurate +5V reference. Each switch produces output exactly equal to +5V if its input is logic high or exactly 0V if its input is logic low. The resistor group between IC7 and IC8 forms an R-2R ladder attenuator; resistors marked 2R have twice the value of those marked R.

The combination of IC7 and the resistor ladder produces an analog voltage proportional to the value of the 4-bit digital data fed into IC7. This signal is then raised to a high level and inverted by video amplifier IC8, which is DC-coupled and must have a high input impedance.

This high voltage analog signal from IC8, applied to the CRT cathode, controls the electron beam current and thus the screen illumination at that point. This is called Z-modulation. Thus the trace brightness at each pixel is set to a value representing how often that element of the signal appears at the scope input.

Four-bit digital data can take only 16 different values. So this scheme allows the trace on a digital scope to display compound signals in 16 different levels of brightness. This is called "grey scaling".

When the display processor IC5 meets a regularly occurring part of the input waveform, it writes a logic high at the appropriate memory address in all four planes of the bit map refresh buffer IC6.

When read from the refresh buffer, the output data on the four parallel lines A, B, C, D will be 1111. The D/A converter IC7 converts this to the maximum analog voltage and the CRT produces the brightest spot at the corresponding point on the screen raster.

Now let's suppose a spurious pulse appears only sometimes at the scope input. Sensing this fact, the display processor IC5 might write a logic high to the corresponding address only in memory plane A of the refresh buffer IC6, and write a logic low to the same address in planes B, C and D.

On the next refresh cycle, when that data stored in the refresh buffer is read, the digital data on output lines A, B, C, D will be 1000. This corresponds to a screen dot of half brightness. This indicates that that part of the signal appears less frequently; so you suspect it's some spurious blip or a faulty pulse.

There are a number of variations on this theme in modern digital scopes. When variable persistence is selected, rapidly changing waveform points can gradually decay through 16 levels of brightness. Some cheaper models support only two levels of grey scaling.

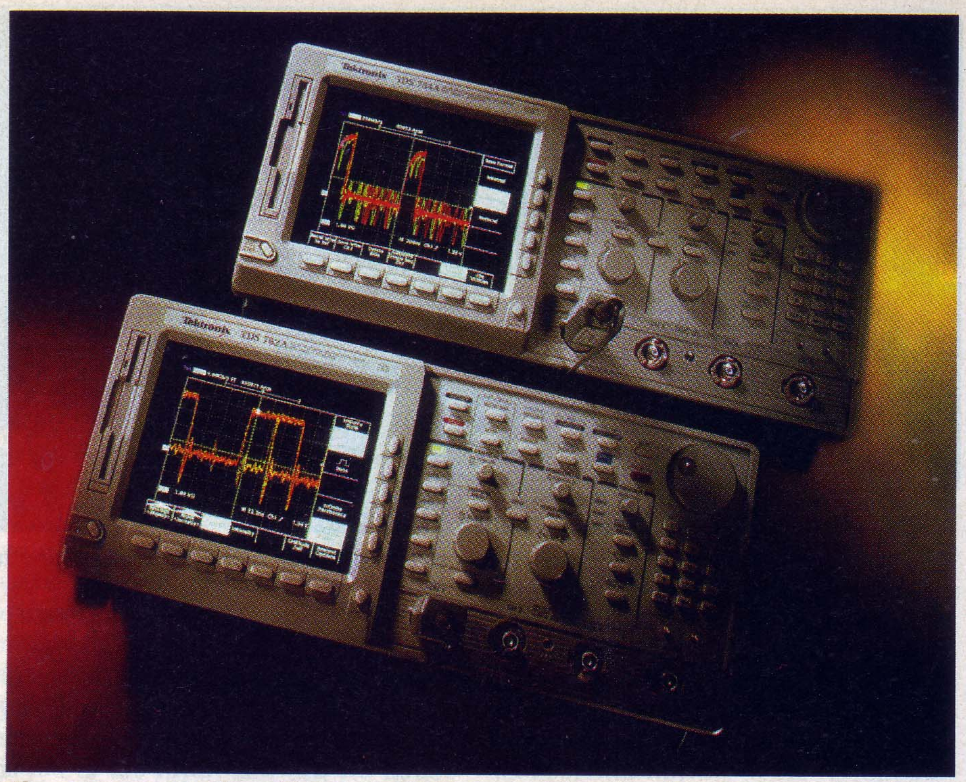
You might ask where's the advantage of digital scopes, when all analog scopes naturally showed brightness scaling? The answer is that DSOs support grey scaling at all sweep speeds equally. But normal analog scopes, at

top speed, are flat out providing a visible trace even on repetitive signals, with no potential left for scaling.

Colour display

Some digital scopes can show a colour graded display, with different colours indicating how frequently some part of a compound waveform repeats. The very high frequency 50GHz Tektronix 11801B uses a 228mm diagonal screen with a vertical raster scan. The display resolves 552 pixels horizontally and 704 pixels vertically, from a palette of 262,144 colours.

Early colour scopes used colour TV technology. The tube contained three electron guns and the familiar tri-colour phosphor and beam convergence shadow mask. But a monochrome CRT is capable of a much sharper trace than any TV tube with a multiple colour phosphor. Therefore many modern colour digital scopes use a white phosphor CRT, overlaid by a three-layer liquid crystal colour shutter. An example of this is the Tektronix model TDS684B which provides horizontal raster scan on a 177mm screen featuring full colour grading from a palette of 256 colour levels.



These two scopes from Tektronix both use a white phosphor CRT, overlaid by a 3-layer liquid crystal colour shutter. Both models are showing colour graded displays, with different colours indicating how frequently some parts of the waveforms repeat

Signal averaging

Analog signals may be corrupted by extraneous interference which results in a noisy display. Worse still, noise in the signal reduces the accuracy of mathematical operations performed by the oscilloscope. The way around this is to feed the noisy signal through your digital scope many times. Then you display the average of many passes of the repetitive input signal.

Each pass will contain different noise, but random (white) noise averages out towards zero. So the average of a number of passes of the same signal will be more like the original uncorrupted waveform.

Say your digital scope takes a record consisting of 500 samples at each pass of the signal. We saw previously how the A/D converts each sample to an 8-bit digital word which represents the

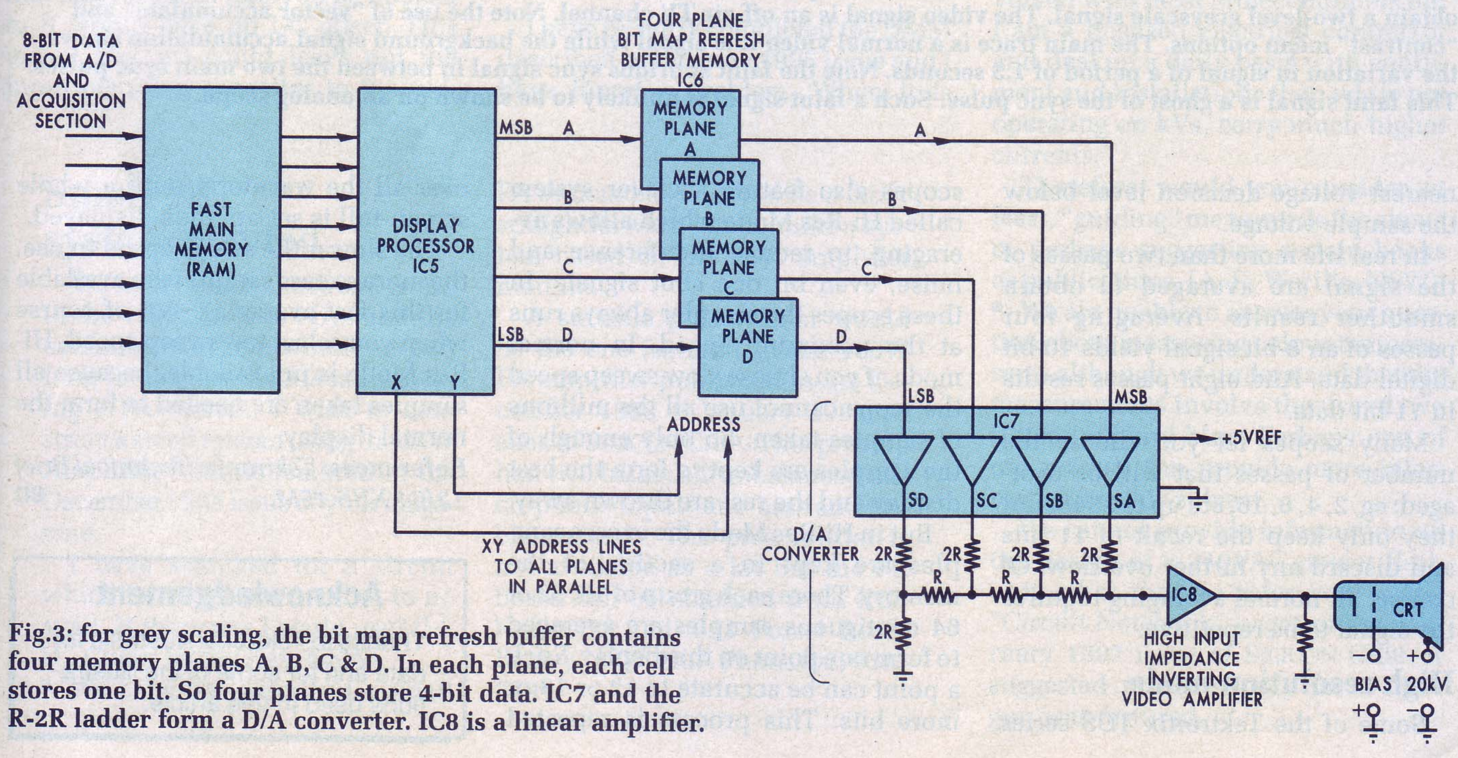
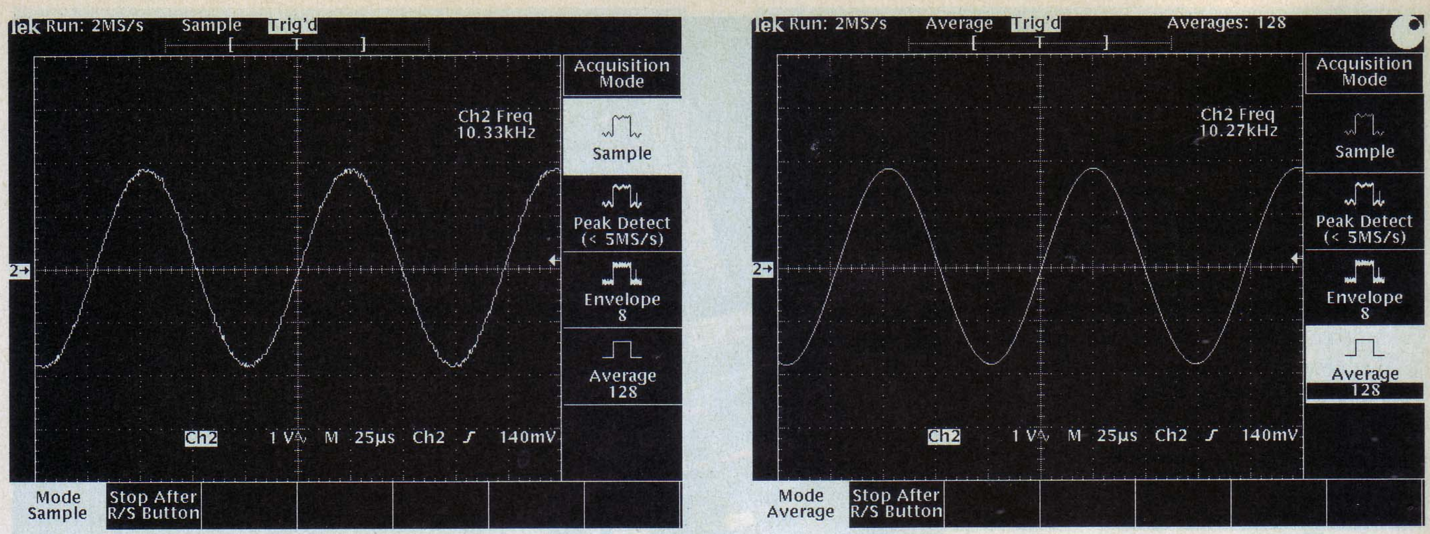
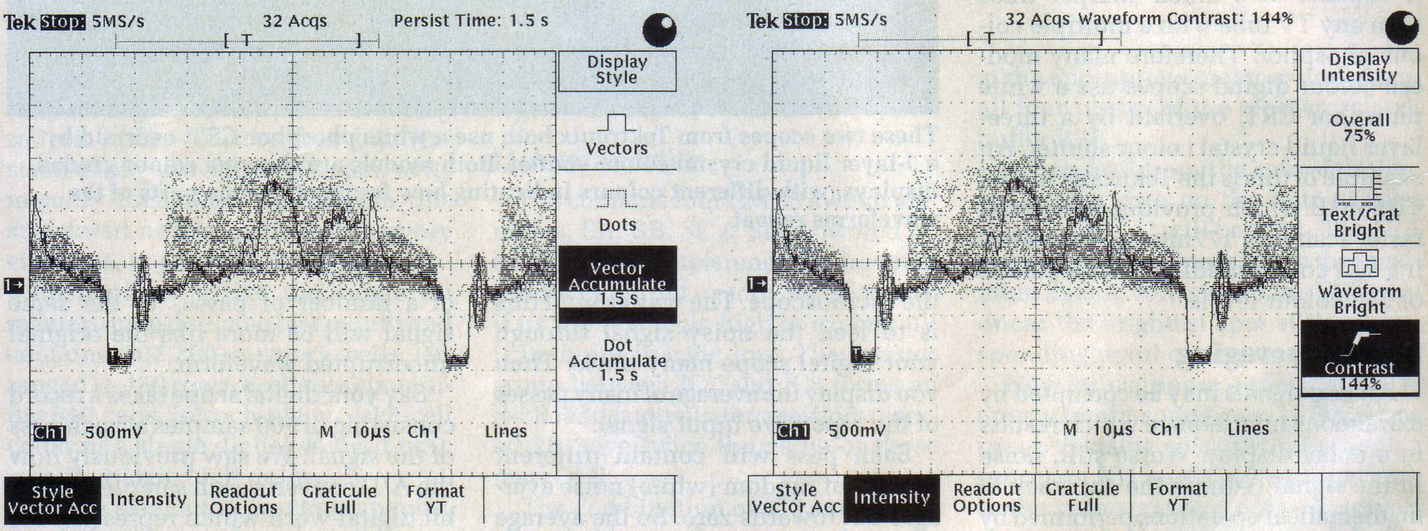


Fig.3: for grey scaling, the bit map refresh buffer contains four memory planes A, B, C & D. In each plane, each cell stores one bit. So four planes store 4-bit data. IC7 and the R-2R ladder form a D/A converter. IC8 is a linear amplifier.



Repeated from the February 1997 issue, these two oscilloscope waveforms show how the use of averaging can remove much of the noise in a repetitive signal.



These two digital screen printouts show the menu setups necessary on a Tektronix RDS 360 digital scope, in order to obtain a two-level greyscale signal. The video signal is an off-air TV channel. Note the use of "vector accumulate" and "contrast" menu options. The main trace is a normal video line signal while the background signal accumulation shows the variation in signal of a period of 1.5 seconds. Note the faint spurious sync signal in between the two main sync pulses. This faint signal is a ghost of the sync pulse. Such a faint signal is unlikely to be shown on an analog scope.

nearest voltage decision level below the sample voltage.

In real life more than two passes of the signal are averaged to obtain smoother results. Averaging four passes of an 8-bit signal yields 10-bit digital data. And eight passes results in 11-bit data.

Many scopes let you choose the number of passes that will be averaged; eg, 2, 4, 8, 16, etc up to 2048. But they only keep the result of 11 bits and discard any further overflow. Of course, all normal averaging requires the signal to be repetitive.

High resolution mode

Some of the Tektronix TDS series scopes also feature a clever system called Hi-Res Mode which allows averaging, to reduce interference and noise, even on one shot signals. In these scopes the sampler always runs at the maximum speed. In normal mode, if you choose slow sweep speed the scope cannot use all the millions of samples taken. So only enough of the samples are kept to form the best display and the rest are thrown away.

But in Hi-Res Mode the excess samples are kept in a section of the memory. There each group of 16, 32 or 64 contiguous samples are averaged to form one point on the display. Such a point can be accurate to 12 or 13 or more bits. This process is repeated over all the waveform until a whole screen-full is set up, then displayed.

The slower the sweep speed in use, the more excess samples are available for this fast averaging. But of course when you select top sweep speed, Hi-Res Mode is unavailable, because all samples taken are needed to form the normal display.

References: *Tektronix: Technical Brief 12/94.XBS.15M.* **SC**

Acknowledgement

Thanks to Tektronix Australia for data and for some of the illustrations used in this article.

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097.

Problem with CHAMP amplifier

I have a problem with the little CHAMP amplifier board, published in the February 1994 issue. This is a great little amplifier and I have used several of these now for different tasks. However, I want to use it to boost the audio output of the SteamSound Simulator, published in the October 1991 issue and also in your publication "14 Model Railway Projects".

I hooked up the input of the CHAMP (ie, the 50kΩ volume control) to the output of op amp IC1c, pin 14, but it won't amplify at all. As I wind up the volume control it seems to distort and then it seems to oscillate. This gets worse as I wind up the volume control and then eventually it cuts out altogether. I also tried taking the output of the SteamSound Simulator from the junction of the two output transistors and the result was much the same. What is the problem likely to be? (G. S., Gosford, NSW).

• This is probably a trap for young players. When we designed the CHAMP PC board, it was assumed that most sources likely to be hooked to it would have no DC offset. This meant that we could leave out the input coupling capacitor to the volume control and thereby make the PC board as small as possible. This very small size has been one of the reasons this project has been so popular.

However, by taking the signal for the SteamSound Simulator from pin 14 of IC1c, you inadvertently applied a voltage of +4.5V DC across the 50kΩ volume control of the CHAMP. As well as being an undesirable practice, because DC through pots makes them noisy, the volume control also feeds this DC to the non-inverting input, pin 3, of the LM386. As the volume control is wound up, more of this DC is fed to the input and this no doubt causes the amplifier to latch up.

The solution is quite simple. You need an input coupling capacitor to the 50kΩ volume control. Normally, if you wanted good response down to low frequencies (say 20Hz), you would need a value of around 0.47μF but since you are using it with the SteamSound Simulator which produces mainly higher frequencies. You can get away with 0.1μF or .047μF.

Faulty display in DMM

I have recently completed the DMM described in the June 1995 issue and I have found a problem. When it is switched to any range, it only displays the negative sign, the HV sign and the number 18.0.8. Moving the display can change this slightly. I have installed all components except R24 which broke during installation but I'm sure this isn't the problem because it's only for the transistor tester. (M. E., Tokoroa, NZ).

• The symptoms you mention suggest that the liquid crystal display is not sitting correctly in contact with the elastomeric connector. We suggest you try repositioning it for correct contact. Failing that, the service department at Dick Smith Electronics should be able to help.

Measuring colour temperature

In respect to the capability of measuring colour temperature in Kelvin degrees, how is it possible? Do professional photographers simply take for granted what is written on their light sources?

I am keen to build a 240VAC-powered studio flash unit. I can understand the danger that would be involved with most project builders but I am a licensed electrical contractor and deal on a daily basis with equipment and installations that, while not operating on kVs, carry much higher currents.

Therefore, would you consider, at least, "guiding" me towards the above or perhaps suggesting certain books or publications. (A. F., Warilla, NSW).

• We are unable to answer your question about measuring colour temperatures although we understand that the measurements involve the use of two filters, red and blue. Perhaps one of our readers can provide more information on this subject.

We cannot provide information on the design of a 240VAC power flash unit other than to refer you to the "Circuit Notebook" pages of the February 1997 issue of SILICON CHIP. A suggested power supply for a flash gun was featured.

Small PA system wanted

We have a small theatrical group in the village where I live and the community hall in which we perform for the residents is sadly lacking a PA system. I wish to construct a small system using the 25W Amplifier Module featured in the December 1993 issue of your magazine.

I have searched for a circuit which I could construct but to no avail. Is there one I could use? (M. H., Chain Valley Bay, NSW).

• We have not described a small PA system but it would be a fairly straightforward job to build a system based on the 25W amplifier module.

A suitable preamplifier would be the one featured in the 120W PA amplifier published in the December 1988 & January 1989 issues of SILICON CHIP. This preamp had two balanced/unbalanced microphone inputs and bass and treble controls. The preamplifier is not available as a kit but the PC board can be obtained from RCS Radio Pty Ltd, 651 Forest Road, Bexley, NSW 2207. Phone (02) 9587 3491.

Unwanted battery drain

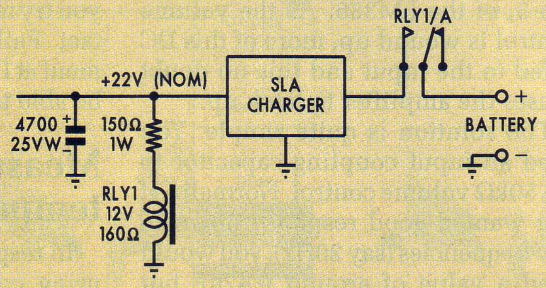
I have built the 6/12V SLA battery charger as described in the August 1992 issue of SILICON CHIP. On switching the charger on, it performed as expected. However, when I turned the charger off, after charging the battery, I noticed a faint glow from LED1, the main charger indicator LED. On checking this, I measured a 5mA current from the battery to the charger. The trouble seems to be in the positive track from the fuse to the 680Ω, 180kΩ and 18kΩ sensing resistors and then via IC1, the charger IC.

I would appreciate it if you could advise me how this 5mA flow can be stopped. (S. M., Townsville, Qld).

• The simple answer to this problem is to manually disconnect the charger when it is turned off. If you want to do it automatically, the solution is to use a relay to connect the charger when power is present and disconnect it when power is removed. You could do this with a 12V relay connected to the DC input to the charger; ie, across the 4700μF capacitor. The relay coil will need a series resistor to prevent over-dissipation.

The DC voltage across the 4700μF capacitor can be expected to be about 22V and the series resistor will need to be the same value or a little less than the relay's coil resistance. For example, if the relay coil resistance is 160Ω, the added series resistor should be 150Ω with a 2W rating. The relay should have a contact rating of at least 5A.

The accompanying diagram shows the concept.



Questions about high power inverters

I am interested in the 600W DC to DC converter published in the October & November 1996 issues of SILICON CHIP. However, I don't need such a high power converter as I only want to run a twin 50W amplifier (±35V @ 2.5A). I also want to keep costs to a minimum.

Can the power output of the 600W converter be reduced by using less Mosfets? What changes would be necessary to produce a power output of around 200W using a similar setup to the 600W converter?

Would it be easier to use the 12VDC to 70VDC converter (April 1993, SILICON CHIP) and will this supply around 2.5 amps (not much more)? Also, could a 200W, 12VDC to 240V AC inverter be modified so it will produce 50-60VAC. Any help you can give is greatly appreciated. (S. G., Tewantin, Qld).

• Changing this design to reduce the output power is not really practical. A better approach would be to use the 100W DC-DC converter published in the December 1990 issue. We can supply a back issue for $7.00 including postage.

Modifying our 200W 12V to 240VAC inverter to produce 60VAC would also not really be practical although it could be done. The main inverter transformer would need to have a lower turns ratio (ie, less secondary turns) and the inverter feedback changed. Ideally you could also use lower rated Mosfets in the H-pack drive circuitry.

High power dimmer doesn't

I have recently constructed the high power dimmer described in the August 1994 issue of SILICON CHIP but it doesn't work. After connecting up, the lamp will come on at full brilliance when the slider pot is at 50% of its travel. There is no dimming action at all.

I have checked the wiring and it all seems OK. (J. N., Leongatha, Vic).

• The fact that you have no control over the brightness suggests that the there may an open circuit in the wiring associated with op amp IC2d and the "set max brightness" trimpot VR3. Check your soldering carefully to ensure that the connections to VR3 and the associated series 4.7kΩ resistor are not open circuit.

Electric fence has no zing

I have built the Electric Fence described in the July 1995 issue of SILICON CHIP. It has been impossible to get high enough output to deter anything. The fence is a single wire obviously well insulated but the output via the coil can be hand-held without discomfort. On completion of the kit, an output spark of 2mm was observed but the coil failed to click as mentioned in the instructions.

We used two coils which were fairly new and were meant to be used in conjunction with a ballast resistor, one a Bosch GT40 and the other an Echlinttil Performance. Both are in excellent condition and there is no discernible difference in performance. This kit was put together with all due care and we've been scratching our heads ever since. Could you please advise what the problem is?

The length of the fence is well below 1km, somewhere slightly above ½km, so it was thought most appropriate for this installation and it has operated successfully with a borrowed Daken B20 12V energiser. (R. D., Boonah, Qld).

• The 2mm length of spark from the high tension output would indicate that the controller is not functioning correctly. We have modified the Electric Fence Controller circuit since publication to provide a 10kV high tension output rather than the original 5kV. This change requires a 1.2Ω 1W resistor in place of the 6.8Ω resistor in series with the coil.

Apart from the need for this change, there should not be any problem with the circuit unless a component is faulty or incorrectly oriented or positioned. The 555 timer is probably functioning correctly since you say a spark is produced, however, it may not be driving Q1 fully into saturation to provide sufficient base current for Q2.

Check that the collector of Q1 goes fully high when switched on and that

the base voltage of Q2 when switched on is about 1V. Note that the 1.5kΩ resistor between pins 6 and 7 of IC1 will need to be changed to a value of about 1MΩ to extend the time to measure this switching when using a multimeter. Take the coil out of circuit when doing this since it will draw excessive current due to the long on-time.

DiscoLight double triggers

I have a technical query regarding the DiscoLight which was described in the August 1988 issue of SILICON CHIP. I have just built one which works perfectly in all modes except it triggers twice on each bass beat. Strobe seems OK but the ALT and Chaser moves in two steps and as there are only four channels only two lights effectively operate. It triggers fine via the Oscillator. Are there any errata for the trigger or squaring circuit? Have you heard of this problem? Any suggestions? (S. S., Melbourne, Vic).

• Double beating when used to trigger from sound is probably caused by there being too much signal. Try adjusting the sensitivity down. You may also find that decreasing the 1MΩ resistor between pins 8 & 10 of IC1c to 180kΩ will improve the result. This provides a much greater hysteresis on Schmitt trigger IC1c.

Overheating Tarago

I have been trying to overcome a long-standing heating problem in my Tarago van. After checking thermostat and repairing the radiator, the hoses, clamps and the head and having the auto transmission checked, all seems to be OK. But I still have an unexplained loss of water and elevated temperature after driving about 100-120km. As a result I am forever topping up the water after every second trip and can never really have any peace of mind when travelling.

I want some circuitry to monitor K-type thermocouples to sense the temperatures of the automatic fluid and engine coolant, both leaving and returning after cooling, as well as the engine oil and ambient air temperature entering the radiator. I'd like to display the readings in pairs using the alphanumeric LCD (May 1993, SILICON CHIP) and be able to recall the maximum reading later.

I feel that by monitoring all the heat sources simultaneously, I can observe the thermal runaway building and catch the offender. I think the trouble is linked to the way the auto is cooled. The engine radiator has a small heat exchanger for the transmission fluid. It seems that at a particular ambient air temperature the radiator cannot handle the load from the auto and this starts the heating cycle off.

At least, I suspect that this is what is going on as it appears to occur during the warmer months of the year. I plan to transplant the system to a friend's 4-wheel drive when I have fixed my problem. I will include the transfer case and both differentials as he does some very serious driving. (T. F., Bundaberg, Qld).

• We have not published any circuits to suit a K-type thermocouple and we do not have any plans to do so in the near future. However, it may be possible to modify the Digi-Temp, as featured in the January 1997 issue of SILICON CHIP.

As published, this circuit will read the temperature at up to eight separate locations at up to 99°C. We have spoken to the designer, Graham Blowes, and he is confident that it could be modified to read temperatures to about 120°C. This could make it suitable for your application.

However, while it is not our normal province to give automotive advice, we think that you have a leak in the cooling system, not a mechanical defect which will be revealed by a temperature monitoring system.

The reasoning is this: if the engine coolant is overheating and causing the radiator cap to vent, no fluid should be lost; it will all go into the overflow bottle. The fact that you have to top up the system frequently points to a leak.

We think that the elevated temperature is caused by the loss of coolant, not the other way around. We strongly suggest that you take your car to the local Toyota service people for a thorough investigation. Leaving it unrepaired will eventually lead to a failure of the alloy head and that will be very expensive to repair.

Poor gas mileage in the Kingswood

I installed the programmable ignition system (March 1996) in my 1974 Holden HQ approximately four months ago. I though this would be the solution I was waiting for, to allow me to change my timing on the fly when changing from petrol to gas and vice versa.

Overall, I am very impressed with its operation, and I have noticed a marked increase in power. But after playing with various settings constantly for the last few months, I am still experiencing a fairly large drop in my gas fuel economy. Before installing the system, I could drive from Melbourne to Benalla and back on one tank of gas, a round trip of approximately 420km. Now, I find that I can only just make the one way trip. Anyway, I am hoping that someone can provide me with some suitable settings to allow for better timing for gas. Please! The price of gas in the country is double that of the city! (R. B., Melbourne, Vic).

• Unfortunately we do not have any information on ignition timing for cars and especially not for use with gas. We can only suggest you take the car to a speed shop which has a dynanometer and exhaust gas analysis equipment. They should enable you to obtain the best compromise between power and economy for your car.

Notes & Errata

Digi-Temp Digital Thermometer, January 1997: the designer of this project has advised that the pinout diagram for the DS1820 sensors is reversed; the GND terminal should be on the righthand side and the +5V on the lefthand side. No damage appears to occur when this wrong connection is made.

Smoke Alarm Panel, January 1997: one of the array of 100µF capacitors on the circuit of page 29, January 1997 should be 10µF. The component overlays are correct. SC

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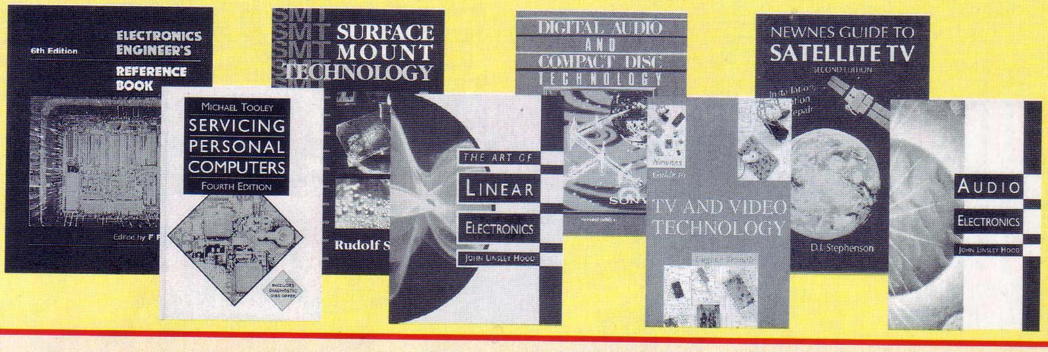

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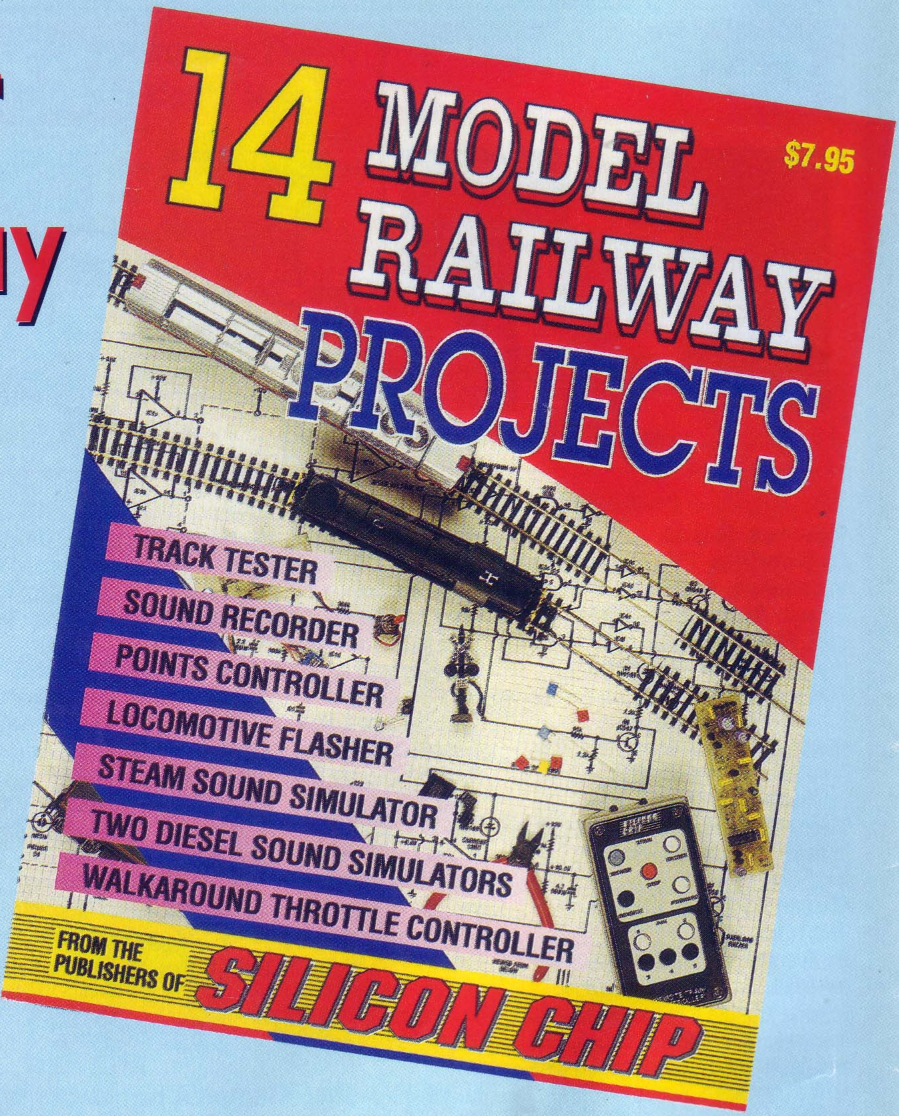

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